MINING CONGRESS JOURNAL

MARCH 1959

In This Issue . . .

Handling water
at Ambrosia Lake
pg. 46

New skip hoist
at Pima
pg. 32

Utility vehicle
at Green Diamond
pg. 34

ALSO . . . Advance Program—AMC Coal Show

DENVER agitator type COAL FILTER

Modern Filters NEED Agitation

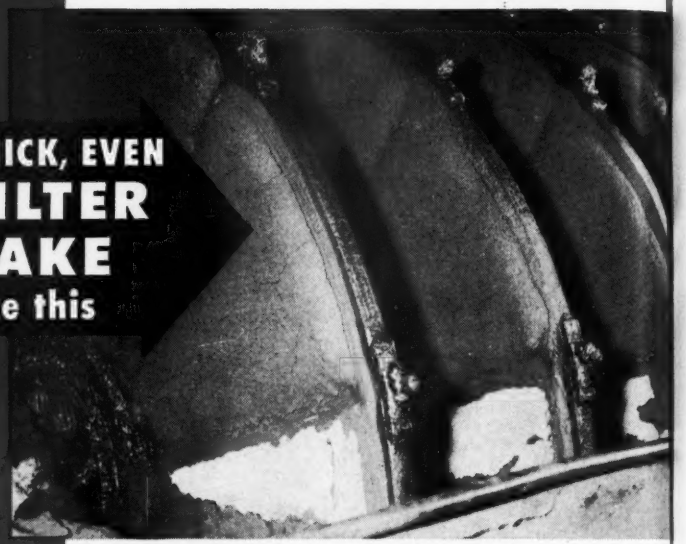
Now...up to 160□' per Disc...*plus*

Use the new space-saving filter that's specially designed to dewater coal fines or refuse... that gives exceptionally high, continuous filtration capacity in minimum floor space. Besides higher output with drier cake, you make these important savings: Lower initial cost, lower power consumption, lower maintenance cost.

Submit Details of Your Dewatering Problem

DENVER Coal Filters or complete fine coal recovery and water reclamation systems are available for all sizes of coal preparation plants. Send a sample of proposed filter feed for laboratory filter testing (no cost to you) and complete recommendations such as correct size filter, vacuum equipment and filter media will be sent to you.

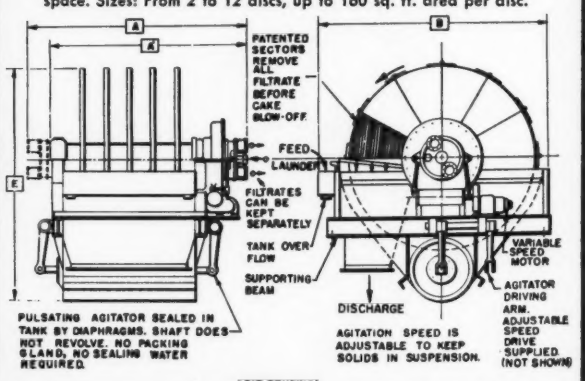
THICK, EVEN FILTER CAKE like this



Tank agitation makes this possible

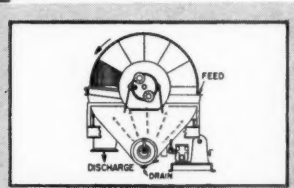
DENVER'S LARGER FILTER CAPACITY

gives greater filter area per square foot of floor space. Saves space. Sizes: From 2 to 12 discs, up to 160 sq. ft. area per disc.

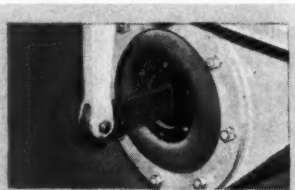

A
K
E
B
PATENTED SECTORS REMOVE ALL FILTRATE BEFORE CAKE BLOW-OFF
FEED
LAUNDER
FILTRATES CAN BE KEPT SEPARATE
TANK OVER FLOW
SUPPORTING BEAM
DISCHARGE
VARIABLE SPEED MOTOR
AGITATOR DRIVING ARM. ADJUSTABLE SPEED DRIVE SUPPLIED (NOT SHOWN)
PULSATING AGITATOR SEALED IN TANK BY DIAPHRAGMS. SHAFT DOES NOT REVOLVE. NO PACKING GLAND, NO SEALING WATER REQUIRED.
AGITATION SPEED IS ADJUSTABLE TO KEEP SOLIDS IN SUSPENSION.

(PAT. PENDING)

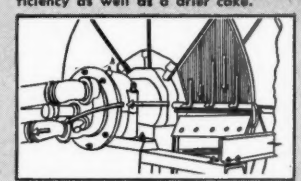
SIZE	AREA PER DISC	A 3-DISC	A 4-DISC	A 6-DISC	A 8-DISC	A 10-DISC	A 12-DISC	B	E	HORSEPOWER FILTER	HORSEPOWER AGITATOR
#75	75 sq.ft.	5'-0"	7'-4"	9'-8"	13"-4"	15'-8"	18'-0"	9'-2"	9'-8"	1-2	1-3
#160	160sq.ft.	6'-11 1/2"	9'-7 1/2"	(2'-3 1/2"	16'-3 3/4"	18'-11 1/4"	21'-7 1/4"	12'-11"	13'-8"	1/2-5	1/2-7 1/2



SIMPLE. Agitation in the DENVER Filter is upwards from the bottom, keeps solids in suspension. Entire tank is active. Gives uniform cake distribution for greater filter and vacuum efficiency as well as a drier cake.



SIMPLE DESIGN. No submerged bearings, no packing gland, no dilution, no grease contamination. Pulsating unit (patent pending) is sealed in tank with tough rubber diaphragm.



PATENTED GRAVITY DRAINAGE removes residual moisture from filter sector. Prevents blow-back, gives drier product. Vacuum is applied longer—both after and before cake discharge.

VARIABLE SPEED drive gives flexibility in agitation speed and disc speed. Filter speed is easily adjusted to suit your requirements.

"The firm that makes its friends happier, healthier and wealthier"

DECO ENGINEERED STANDARD RELIABLE 24 HOUR SERVICE EFFICIENT

DENVER EQUIPMENT COMPANY

Cable DECO DENVER — Phone CHerry 4-4466

1400 Seventeenth St. — Denver 17, Colorado

NEW YORK CITY
4114 Empire State Bldg.
Phone CH 4-6510

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15-17 Christopher St.
Finsbury Square
Phone Monarch 3750

JOHANNESBURG
9th Ave. and Broadway
Bez Valley
Phone 25-7531

TORONTO
185 Bay Street
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802 Credit Foncier Bldg.
Phone Marine 4918

MEXICO CITY
Avenida Juarez 14, Desp
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Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

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ON OUR COVER

Articles in this issue describe the interesting conditions and equipment pictured on the cover—(Upper left) water being drained from drill holes at Ambrosia Lake—(Below) an electrified jeep adapted for general utility service at Green Diamond—(Right) Pima's new skip-hoisting installation in Arizona.

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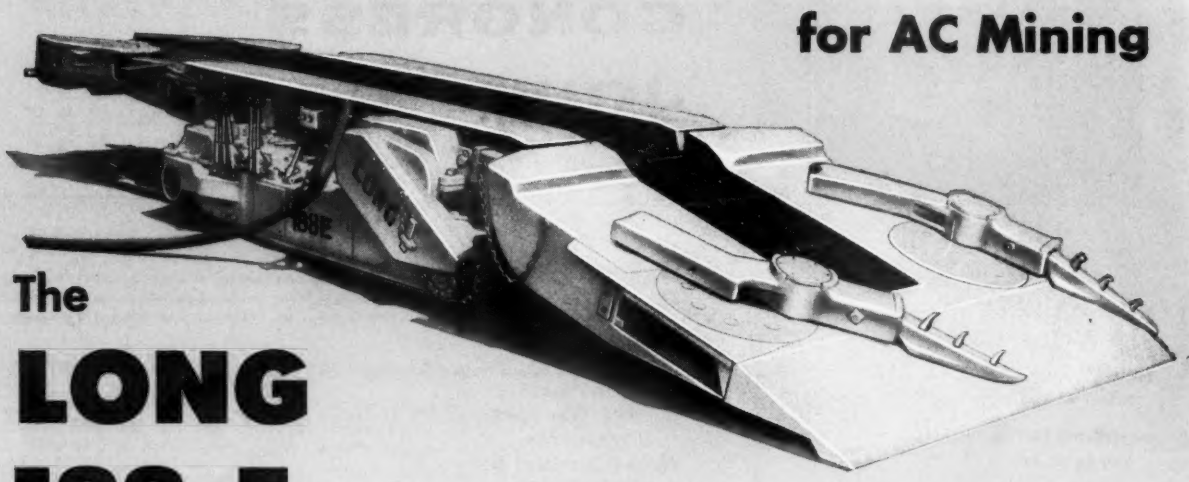
NEW from LONG . . .

Low Height, high performance 80 HP loader for AC Mining



The LONG 188-E

Makes Maximum Use of AC design advantages

Unlike DC motors, AC types do not develop maximum torque when starting—also high inrush currents are characteristic with AC motors starting loaded. In the LONG 188-E, a single 80 HP motor powers the machine through clutches with full pull-out torque available. This single motor is started light and runs continuously during operation, with all machine functions controlled by a single bank of finger-tip control valves. The result—inrush and torque problems characteristic of multi-motored designs are eliminated. In addition to the 80 HP motor, one circuit breaker, one size 4 contactor, and one pushbutton complete the electrical circuit of this powerful loader.

Offers greater simplicity—top performance

Only LONG manufactures single motor gathering arm loaders with full independent crawler control. This highly successful feature permits the machine to turn in its own length and, combined with extra length crawlers, extra power and high speed gives the 188-E maximum maneuverability.

Provides high-capacity operation

The 188-E, with its greater power, stepped-up speed and clutch capacity, will maintain loading rates of 8-10 tons per minute in heavy going.

Costs less initially—less to maintain

With no more than half the moving parts of most multi-motored designs, the 188-E can be depended on for lowest possible maintenance costs, plus economies in spare parts inventory. Simpler design is reflected in important savings in first cost also.

The LONG 188-E is available in overall heights as low as 25¾". Machines specially designed for rock and other minerals also available.

Write for details or a demonstration.

The LONG Company
Oak Hill, W. Va.

He wastes no time!

He pinpoints faults with an O-B Locator!

When a fault hits his trailing cable, he wastes no time. He pulls the plug and goes for his O-B Cable Fault Locator.

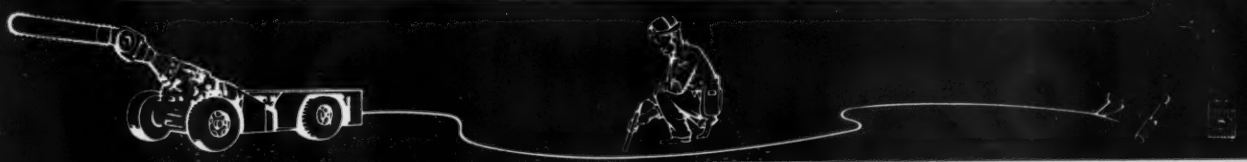
It takes him only a minute to clip two leads to the power conductors, two to the small six-volt battery—and he's ready for testing. Testing is simple too—a slow walk back along the cable with earphones and slim transistor receiver. When he hears a change in signal he's found the short or open and can make repairs.

If you've been wasting too much time tracking down hidden faults, you could use an O-B Locator, too. It's pocket size, weighs only four pounds, costs less than any cable you'll use it on. Send for Booklet K-423 for complete information.

Ohio Brass

MANSFIELD OHIO, U. S. A.

IN CANADA: CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT.



More tonnage . . . more profits

50% Higher Tonnage with the *new* CM37

For medium and high seams

Backed by the tried and proven cutting principle of the original Lee-Norse Miners, the CM37 brings a new high in operational efficiency to continuous mining. This rugged machine has more power, more capacity and higher tramming speed that results in increased tonnage per man shift.

Check these NEW FEATURES!

1. Total weight 25 tons—a 25% increase! Extra weight mostly in improved cutter head where it does the most good!
2. More power—fewer motors! Only 3 identical electric motors used . . . conservative continuous ratings . . . no water cooling.
3. Heavy duty electric control.
4. 14" wide crawler treads with improved hydraulic motor and gearing.
5. 24" wide conveyor driven by hydraulic gear motors applied directly to gathering head. Hydraulic start and stop . . . no clutch required.
6. Multiple tramming speeds—variable speeds to 50 feet per minute . . . fast tramming at 90-100 feet per minute.
7. Increased capacity...4 to 5 TONS PER MINUTE.

Coal high or low? . . .

. . . with Lee-Norse MINERS

For Low Coal . . .

LCM28

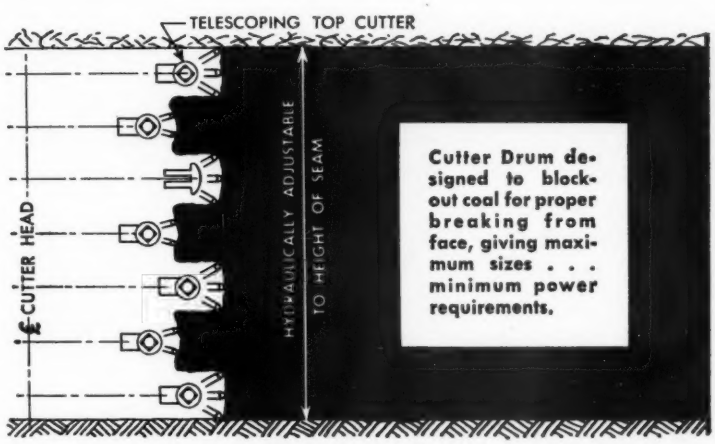
ready for production!

For seams 30" to 48"

Here's how LCM28 *produces profitable tonnage!*

1. Weight 16 tons — rugged and heavy enough to cope with tough cutting conditions.
2. Capacity—2 to 3 tons per minute.
3. Hydraulically driven 24" flexible Conveyor.
4. Two Cutter Heads cut a wide face 16 feet or less.
5. Dual gathering arms have maximum reach of 11 feet . . . will gather ALL the coal regardless of position.
6. Controlled Tramming Speed gives proper sumping action and Dual Pump combination gives high tramming speed.
7. Especially good in cross-cut development!

The LCM28 "Low Coal" Miner employs a new combination of cutting and gathering coal. The vertical mounted extendable cutter drums arc together like a "clam shell."


TELESCOPING TOP CUTTER
CUTTER HEAD
HYDRAULICALLY ADJUSTABLE TO HEIGHT OF SEAM
Cutter Drum designed to block-out coal for proper breaking from face, giving maximum sizes . . . minimum power requirements.

All Lee-Norse Miners are available in AC or DC power.

Lee-Norse Company
CHARLEROI, PENNA.
Specialists in Coal Mining Equipment

Lee-Norse MINERS keep production on the go!

US RUBBER CONVEYOR BELTS

"After 20 years, 'U.S.' still gets the replacements," says plant foreman

Mr. James Campbell of Guyan-Eagle Coal Co., Kelly (West Va.), knows why Guyan-Eagle has been using (and replacing with) "U.S." belts for the last two decades... why today they have 17 belts operating in their 5 mines. In the words of the company's own officials, U.S. Belts are:

"The most dependable in our experience."
"Resistant to abrasive action of rock."
"Strong, durable – maintenance is minimum."

That's why, when Guyan-Eagle opened its latest mine (No. 5) it was no surprise that they equipped the system with "U.S." Belts to move the 5,000-ton daily output. *Once a "U.S." Belt user, always a "U.S." Belt user.*

The 6 "U.S." Belts in No. 5 mine range in size and capacity from the 195', 42"-wide stoker coal conveyor up to the 1700' main slope belt, a 48"-wide U.S. Giant® carrying 515 tons of ROM coal (up to 500-lb. lumps) to the shaking screens in the scalping plant. All are performing perfectly.

• • •

When you think of rubber, think of your "U.S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and the finest quality industrial rubber products.

US RUBBER Mechanical Goods Division

United States Rubber

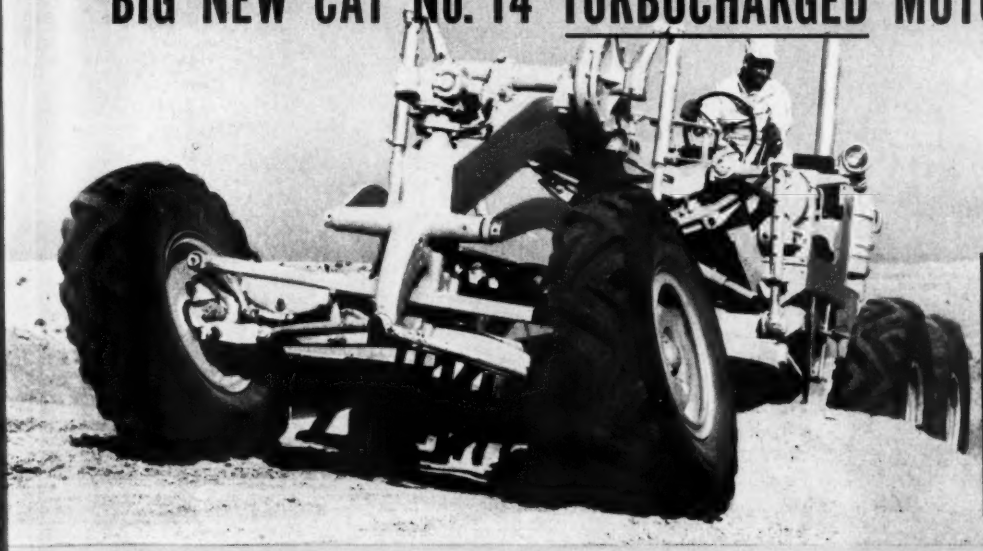
WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

CATERPILLAR'S PROJECT PAYDIRT

***PROJECT PAYDIRT** pays off for you again*

BIG NEW CAT No. 14 TURBOCHARGED MOTOR GRADER



PROJECT PAYDIRT: Caterpillar's multi-million-dollar research program—to meet the continuing challenge of the greatest construction era in history with the highest production earthmoving machines ever developed.

ENGINE HP (rated at sea level)—150. **BLADE,** standard—12 ft.; optional—14 ft. **TIRES,** all around—14.00-24.
WEIGHT—29,280 lb. **TRAVEL SPEEDS,** 6 forward and 2 reverse—2.6 to 21.6 MPH. **TURNING RADIUS**—36 ft.

IN THE new No. 14 Series B, Caterpillar brings you the most versatile grader in the "big machine" field. Another major achievement in "Project Paydirt," the grader answers your need for a giant unit that comes through dependably with higher, faster, lower-cost production for you on today's big jobs.

The first and only Turbocharged motor grader, the 150 HP No. 14 operates at highest practical working speeds with either a 12-ft. or 14-ft. moldboard. It incorporates the latest engineering advances developed by Caterpillar research with exclusive time-tested Caterpillar features. Some are shown here, but there are many more. They all pay off in this one fact: You can use the No. 14 profitably on—

—power applications like heavy spreading, ditching, grading and bank sloping.

—control applications like light spreading, fine grading, blading and maintenance.

As a result, this big all-purpose grader will earn its keep on every job with high capacity and low operating cost. But see for yourself. Get the complete facts about the No. 14 from your Caterpillar Dealer. Say when and where—he'll demonstrate!

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

ADVANCE FEATURES OF THE NO. 14

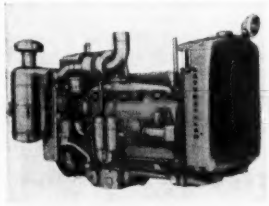
EXCLUSIVE OIL CLUTCH: Provides up to 2,000 hours' service without adjustment, equal to about 12 months' "adjustment-free" operation.

POWER STEERING AND POWER BRAKES: Provide fast, positive response and ease of operation that help operator maintain high production anywhere.

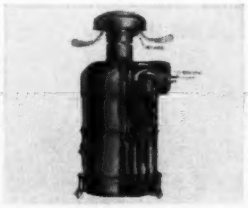
TUBELESS TIRES—14.00-24 (10-PLY RATING): All tires mounted on wide 10-in.-rims to stiffen tire side-walls and reduce tire "roll." Large tires on grader's front end improve the machine's stability.

EXTRA STRENGTH FRAME: Heavy frame, drawbar and circle are ruggedly built to match engine power.

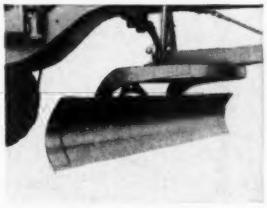
UNEQUALED VISIBILITY: An operator, while seated, has an unobstructed view of critical areas at the front wheels, blade toe and circle.



TURBOCHARGED CAT ENGINE: First and only Turbocharged engine in a grader. Engine provides high 18% torque rise.



NEW DRY-TYPE AIR CLEANER: Removes 99.8% of all dirt from intake air during every service hour. Can be serviced in 5 minutes.



HIGH THROAT CLEARANCE: New design permits increased clearance between moldboard and circle for greater loads.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

DIESEL ENGINES • TRACTORS
MOTOR GRADERS
EARTHMOVING EQUIPMENT

BORN OF RESEARCH... PROVED IN THE FIELD

ENEMY OF WEAR,
DOWN TIME AND WASTE
AT BUCKHORN MINE

Processing plant of Bell & Zoller's Buckhorn Mine, Johnston City, Illinois uses STANOLITH Grease MP.

STANOLITH GREASE MP

Situation: As with every underground mine, equipment at Buckhorn Mine is susceptible to wear unless moving parts are protected with a grease film that stays in place regardless of heat, water or dirt.

What was done: Buckhorn Mine management knew where to turn for assistance on lubrication and experienced advice on how to protect equipment from wear. They called on Standard Oil mine lubrication specialist Hervie Dillingham. Hervie recommended STANOLITH Grease MP. This lithium grease is particularly suited to mine lubrication jobs because of its (1) ability to shield parts from grit and dirt, (2) resistance to both high and low temperatures and (3) resistance to water wash out. STANOLITH Grease MP holds its consistency even under the severe working conditions encountered in the lubrication of mine equipment. With its ability to provide lubrication over a wide range of applications, fewer greases need to be inventoried. One drum of grease instead of many different ones reduces costs, saves handling on the job, eliminates application mistakes.

What you can do: Let a Standard Oil lubrication specialist help you find ways to eliminate your lubrication problems. One of these men is on the staff of each of the 48 district offices in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

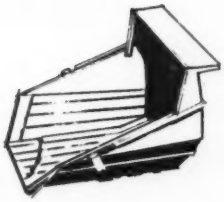
You've got to get down there to see the problem. Standard's Hervie Dillingham does just that. Hervie has experience and training to know what's needed. He has been providing technical service to mines for more than 20 years.

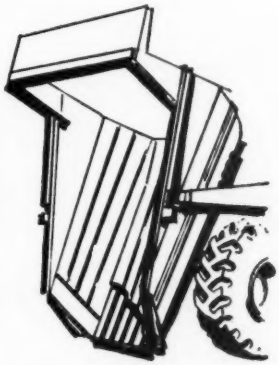
Quick facts about
STANOLITH Grease MP

- Capable of providing superior lubrication over a wide range of applications
- Water resistant
- High temperature resistant
- Pumpable in grease gun or pressure system
- Mechanically stable

YOU EXPECT MORE FROM **STANDARD** *AND YOU GET IT!*

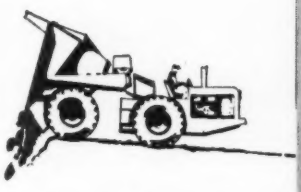
Haul problems?





Easier loading—Wide bowl offers large "target" for easy-loading without spillage. Open rear of body provides wide, low entry for dipper—an extra speed advantage for your shovel.

Resist body shocks, damage— Rear-Dump stands up under heaviest loading jolts. Bowl is all steel — no wood fillers. Floor is lined with heat-treated tool-steel strips, welded to solid billets laid over heavy steel plate. Sloping sides deflect load shock, quickly cushion small floor area with layer of material against rock-damage.

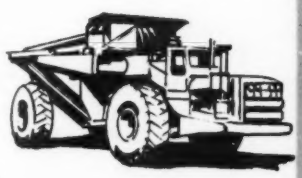


L-W Rear-Dump may be your answer!

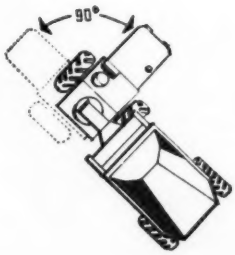
No two hauling jobs are exactly alike. Each has its own particular problems. There are long hauls and short... all types of earth-born materials. Some jobs have restricted loading and dumping areas. Others tough grades, rough temporary haul roads. And there are wide variations in maintenance and repair problems — depending on loads, abrasive material, shock, weather, and available facilities and servicemen. So finding the *right kind* of hauler to solve your present and future problems isn't easy. That's why we think you might like to check these "problem-solving" features found only on LeTourneau-Westinghouse Rear-Dumps. All these special advantages of this off-road hauler are available on all three sizes: 11, 22, 35 tons load capacity... 138, 226, or 335 hp. And, to ensure steady earnings for you, other hauled units can be used behind same Tournapull® 2-wheel prime-mover. These include scrapers, bottom-dumps, flatbeds.

Quick, positive dumping— Flick of fingertip switch on control panel instantly activates point-of-action electric hoist-motor. Body raises quickly to desired angle. At full dump position, edge of bowl is low behind rear wheels... material cannot roll forward to lodge against wheels, nor pile under rear end. Streamlined body sheds stickiest material readily. Front-wheel drive keeps power and traction on solid footing—well ahead of rear wheels — when dumping over high banks.

Hauls anywhere— Machine's big, low-pressure tires—5 to 6' tall, 1½ to 2' wide — "float" machine over sand, mud, rocks, RR tracks, or other obstacles. Broad tire-lugs maintain traction in any type of material. Power-transfer differential puts up to 80% of power on drive wheel with firmest footing, when either powered wheel begins to spin. Electric pivot-turn, through geared kingpin, lets operator "walk" prime-mover out of soft spots. Dumping action can also be used to "hump" hauler off a soft bank.



Faster spotting—Positive, electric power steer, through geared kingpin... pivots prime-mover to right angle for short 90° turns. As a result, unit makes continuous U-turn in less space than Rear-Dump's own length. In dump position, it turns in only about ⅔ of over-all length! Result? You spot faster at the shovel... grizzly or hopper... and get away faster from congested pit or dump areas.



Simplified construction— Look underneath a Tournapull Rear-Dump... note that this machine needs no springs, no tie rods, no hose and pipe lines, no frame, no long drive-shaft that require maintenance and repair. In place of a foundation frame and body sub-frame, Tournapull prime-mover and trail-unit are hitched together by means of a high horizontal yoke. Yoke pivots horizontally on kingpin at front... then extends back along side of bowl, where it pivots vertically just above and ahead of rear wheels. This vertical and horizontal kingpin arrangement provides an easy oscillating action that eliminates most twisting, tilting strains... permits higher speeds on uneven ground.

R-1852-G-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

Any way you look at it...

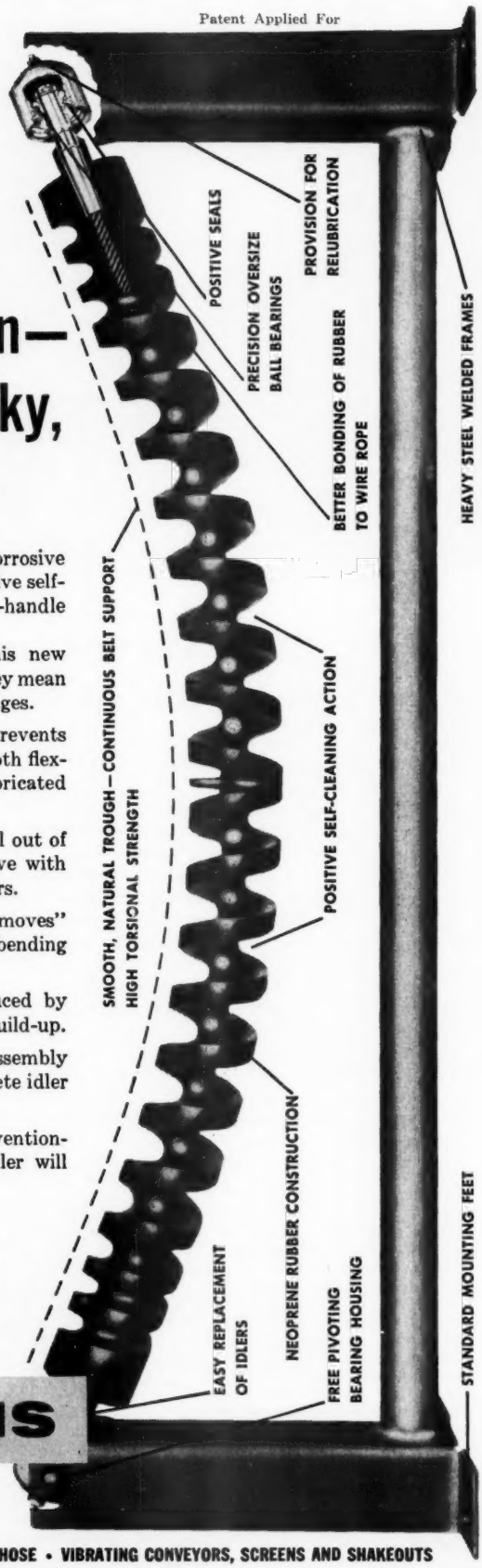
New Rubber Spiral Idler Defies Corrosion, Abrasion—Prevents Build-up of Sticky, Hard-to-Handle Materials

Here's the conveyor idler built to last longest in punishing corrosive atmosphere or extreme abrasive service! What's more, its exclusive self-cleaning rubber spiral prevents build-up of sticky, hard-to-handle materials!

The numerous design and construction advantages of this new Hewitt-Robins idler are shown in the illustration. Here's what they mean to you in terms of cost-cutting, time-saving, operating advantages.

- **LONG LIFE.** Neoprene spiral, completely covering wire rope, prevents attack in corrosive atmosphere. Uninterrupted spiral gives smooth flexing, maximum strength. Precision sealed bearings can be relubricated for still longer life.
- **SELF CLEANING.** As the spiral turns, it "works" any material out of the grooves as they change shape. This action is most effective with sticky materials which tend to build up on common types of idlers.
- **CONTINUOUS BELT SUPPORT.** The new rubber spiral design "moves" along the entire width of the belt; therefore, pinching and sharp bending of the belt are eliminated.
- **SELF TRAINING.** Belt training problems are greatly reduced by readily conforming rubber spiral, and by elimination of material build-up.
- **EASY REPLACEMENT.** The spiral, wire rope, and bearing assembly simply lifts out of its brackets—no tools are needed. The complete idler fits standard conveyor stringers.
- **TRUE OPERATING ECONOMY.** Under conditions where conventional idlers fail prematurely, the Hewitt-Robins rubber spiral idler will pay for itself many times over.

Deliveries of this revolutionary new idler are now being made in 18, 24, 30, and 36 inch belt sizes. In addition to the type shown, it is also furnished with a spreader frame for use in wire rope conveyor systems. For further information check your H-R distributor, or write Hewitt-Robins, Stamford, Connecticut. Ask for Bulletin 3-15.



HEWITT-ROBINS

THE NAME THAT MEANS EVERYTHING IN BULK MATERIALS HANDLING SYSTEMS...

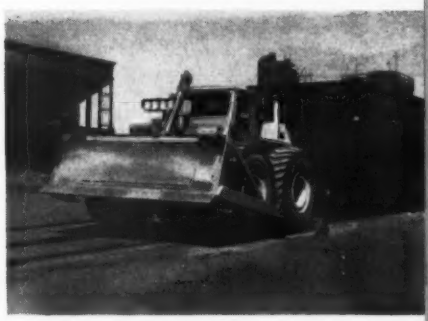
CONVEYOR BELTING AND IDLERS • POWER TRANSMISSION DRIVES • INDUSTRIAL HOSE • VIBRATING CONVEYORS, SCREENS AND SHAKEOUTS

Works for you...

...runs to its next job...

Let your neighbor share the cost of your new tractor

...and works for a neighbor



If the high-speed performance of a big, modern, rubber-tired tractor appeals to you — but your work-load doesn't seem heavy enough to justify the investment — here's a money-saving idea: *let your neighbors share your cost.* A modern tractor-on-rubber *works* so fast, *travels* so fast, that it can serve *several* users.

There are various ways to handle this "cost-sharing". Some owners rent their rubber-tired tractors to nearby pits and plants for a couple of hours a day, on a set schedule. Some furnish tractor-and-operator on a "call when needed" basis. Others include several stops on a daily cycle.

Must meet these requirements...

Whether or not the plan works depends on the speed and performance of your tractor. First, it must get *your* work done... quickly, economically. The tractor must be fast and mobile, so you can dispatch it to your "customers" easily. And, with this extra schedule of work, it must be able to "take it".

With these requirements in mind, consider how LeTourneau-Westinghouse Tournatractor® lends itself to this type of operation:

218 hp... excellent traction...

Tournatractor gets *any* work done in a hurry. With 218 hp, and excellent traction from 4 big, low-pressure tires, it matches or tops slow crawler-tractors in "push-power", in all but rarely-used speeds under 2 mph. Fast acceleration, big, sure-stop brakes, independent steering clutch speed up maneuverability. And its constant-mesh transmission gives you *instant*-shift, *non-stop* speed selection.

Versatile, too, Tournatractor can be equipped with dozer blade, Angle-dozer®, root rake, snow plow, side boom, tree stinger, push block, winch, railroad coupler. It will pull all standard drawbar tools. With a rear-mounted power-control-unit, it will operate cable-controlled scrapers, other cable-type attachments.

Drives to work anywhere

Tournatractor *runs* from job-to-job under its own power... doesn't need ramps, trailers, trucks. Its big tires roll over paved roads, open fields, rails, with equal ease. And its 17 mph speed lets you reach a pit 4 miles away in only 15 minutes!

Long hours, heavy work, never hurt rugged Tournatractor. Owners' cost records prove it to be remarkably economical to maintain. Its shock-absorbing tires, heavy steel framing, and load-smoothing torque converter keep this unit working productively day after day, month after month.

Talk over this double-duty profit possibility with your LeTourneau-Westinghouse Distributor. And ask for a demonstration of Tournatractor.

CT-1648-MQ-1

LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

Here's a complete handbook on Wire Rope!

Here — in a compact book — is the information you can use to reduce your yearly rope costs. It's free to wire rope users . . . just ask for G16: Macwhyte's "Blue Book of Wire Rope."

This completely indexed, pocket-sized book lists rope sizes, strengths, weights, lays, sheave sizes, and materials, plus inspection and lubrication procedures.

Reach for Blue Book G16 any time you need wire rope information. And for cost-saving recommendations on the right rope to use for each type of service, ask for a Macwhyte representative to call.

MACWHYTE WIRE ROPE COMPANY,
2906 Fourteenth Avenue, Kenosha, Wisconsin

Manufacturers of Internally Lubricated PREformed Wire Rope; Braided Wire Rope Slings; Aircraft Cables and Assemblies; Monel Metal, Stainless Steel, Plastic-Coated and Nylon-Coated Wire Rope; and Wire Rope Assemblies. Special catalogs available.

MILL DEPOTS: **New York 4,** 35 Water St. • **Pittsburgh 36,** P. O. Box 10916, 353 Curry Hollow Road • **Detroit 3,** 75 Oakman Blvd. • **Chicago 6,** 228 S. Desplaines St. • **St. Paul 14,** 2356 Hampden Ave. • **New Orleans 2,** 144 Thalia St. • **Ft. Worth 1,** P. O. Box 605 • **Portland 9,** 1603 N.W. 14th Ave. • **Seattle 4,** 87 Holgate St. • **San Francisco 7,** 188 King St. • **Los Angeles 33,** 185 S. Myers St.

129

MACWHYTE WIRE ROPE

Wire Rope made for a purpose—to serve you better

UNIFORM QUALITY...
CONSISTENT PERFORMANCE...
MAXIMUM SERVICE...

you get them all with

CARDOX®

carbide-tipped bits

Job-proven to give you *more* . . . in production, performance and service! In "show-down" tests in mine after mine, Cardox bits maintain a lower "cost-per-foot cut or drilled" rating than any other. It's no secret why . . . Cardox carbides are job-matched to meet your specific mining requirements, whether it be drilling or cutting. They are made to uniform quality standards . . . bit after bit, they deliver the same consistently high production output, the same long service life. They make continuous mining more continuous. Want proof? We'll be glad to run a test at your mine. You name the time, place and conditions. Bits available in all sizes and styles.

and

heat-treated alloy steel

augers

The all-new Cardox roof auger gives you 2-to-1 peformance over all others. Strong, rugged, long-lasting . . . Cardox roof augers are constructed of tough alloy steel, welded—then heat-treated for added strength and abrasion resistance. An extra pitch of flight at the shanks end provides added strength at the point of stress. In standard lengths from 10" on up; other Cardox augers are available from 1¼" to 48" in diameter. Same high quality, same high performance.

immediate service

lasting satisfaction

You can rely on Airdox-Cardox for straight practical answers to your mining problems. We offer you a unique combination of experience, know-how, broadest distribution and stocking facilities, and available qualified underground personnel to answer your needs efficiently, effectively and economically. Call on us . . . where there's coal, there's . . . AIRDOX-CARDOX!

AIRDOX CARDOX PRODUCTS CO.

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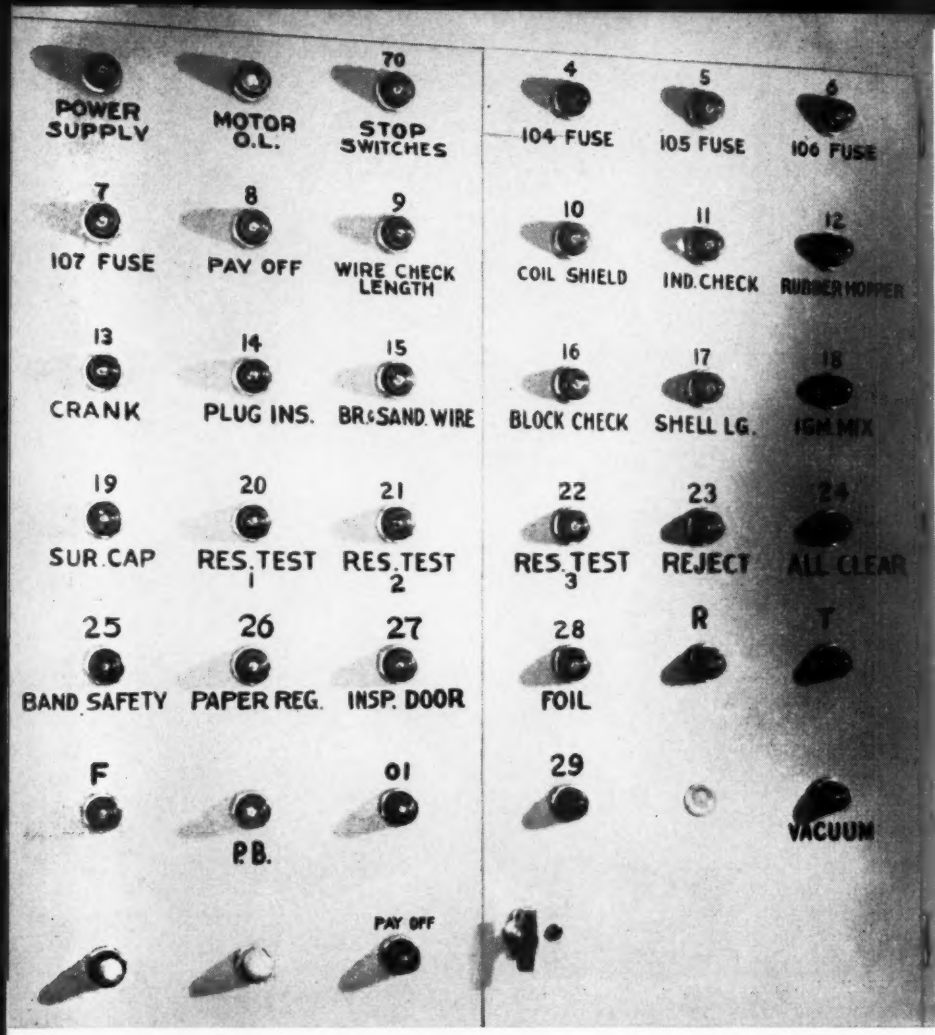
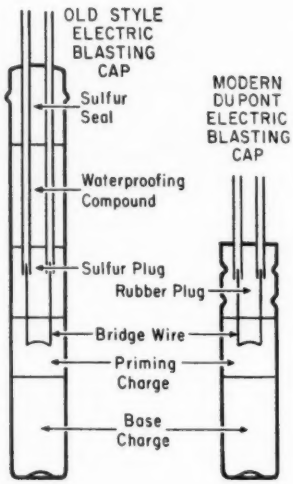
OTHER AIRDOX-CARDOX PRODUCTS . . . Airdox and Cardox Non-Explosive Mining Methods . . . Auger Miners . . . Rotary Drills
Cardox Central Compressing Systems for Air Motors . . .





SEE THE DIFFERENCE—The one at the right is the **modern** DuPont cap. It's shorter, easier to prime, but has the same load.

THIS CONTROL PANEL guides the assembly of every DuPont electric blasting cap you buy. It's the electronic "front office" of the world's most modern (**fully automatic**) blasting cap assembly line.

No chance of human error...

in this electronic "headquarters" of the world's most modern blasting cap factory...means even more dependable, more uniform caps for you

Here's the latest example of DuPont leadership in the development of better, safer blasting caps... a revolutionary, new, fully automatic, electronically-controlled manufacturing process to eliminate the possibility of human error.

Every step in the process, from automatically loading the shell to applying the shielded shunt and paper band, is electronically controlled. And as each cap goes through the line, it is inspected and tested dozens of times—automatically rejected if it doesn't meet our rigid standards.

AND NOW CONSIDER ALL THESE OTHER DU PONT ADVANTAGES...

1. The synthetic rubber plug which eliminated the old-fashioned sulfur plug, waterproofing compound and sulfur seal, giving a waterproof cap with a much shorter shell, easier to prime.
2. The famous shielded shunt which shorts the leg wires and positively shields them from outside sources of electricity.
3. Plastic insulation, more efficient, easier to see, easier to strip.

You get all these benefits with every DuPont blasting cap you buy... both regular and delay... at *no increase in cost.*

SEND FOR THIS FREE BOOKLET! See for yourself how DuPont makes electric blasting caps in the world's most automatic blasting cap factory. Read how automatic testing at every stage of manufacture assures you of the highest, most uniform quality.

Ask your DuPont representative for a copy, or write to Explosives Department, 2543 Nemours Building, E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Del.

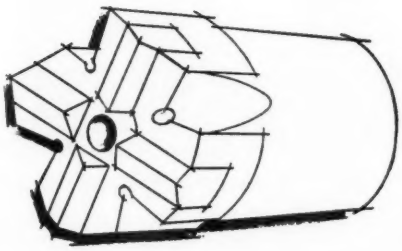
DU PONT BLASTING CAPS

DU PONT REG. U.S. PAT. OFF.

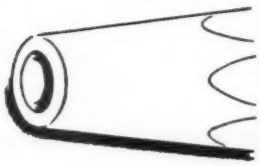
Products of DuPont Research

BETTER THINGS FOR BETTER LIVING... *THROUGH CHEMISTRY*

NOW!



REMOVABILITY



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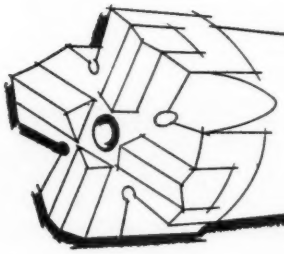


ONE-PIECE STRENGTH

IN AN AIR-LEG BIT!

AIR-LEG drillers, now you can have your cake and eat it, too. The new Timken® tapered socket carbide insert bit is removable—yet gives you the strength of one-piece steels. The secret is the taper. It gives you all the advantages of removability with a strong, secure union.

Here are a few of the plusses you get with the Timken tapered socket but can't get with intraset steels because they're not removable.

1. You don't have to throw away the drill steel just because the carbides wear out. You do with an intraset steel.

2. You carry just a pocketfull of bits into the mine. Try putting an intraset steel in your pocket.

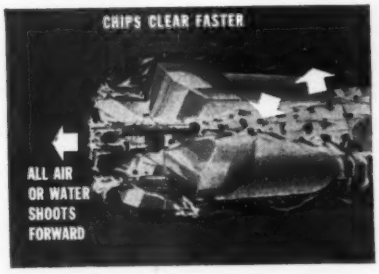
3. You can quickly change bit gauge sizes using the same steel. With an intraset steel, you have to change a whole steel.

4. You don't have to lug the whole steel back to the shop to resharpen the cutting edges. You do with a 4-point intraset steel.

5. You get four carbide cutting edges. You get only two with a chisel intraset steel.

And you get further economies because the Timken Tapered Bit clears chips faster. The picture at right shows you how. New special-analysis carbide inserts give superior wear-resistance with added shock-resistance. And they can be reconditioned many times.

For removability *and* strength, use the air-leg bit of the future. Write for our free brochure. The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO".



CHIPS CLEAR FASTER because 1) new five front holes shoot water or air directly against the rock face and 2) new deeper, wider wing clearance lets chips wash back faster.

TIMKEN

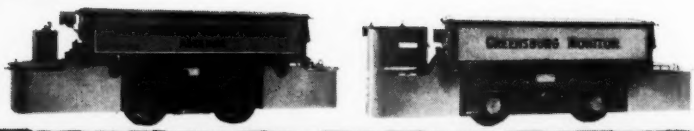
TRADE-MARK REG. U. S. PAT. OFF.

AVAILABLE NOW!

THE AIR-LEG BIT OF THE FUTURE

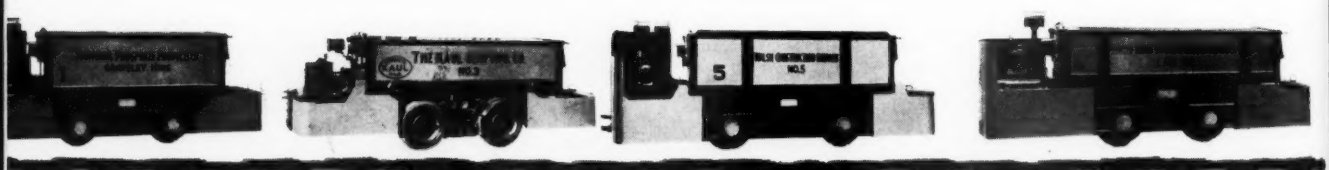
National Mine Service Company

GREENSBURG MINE LOCOMOTIVES

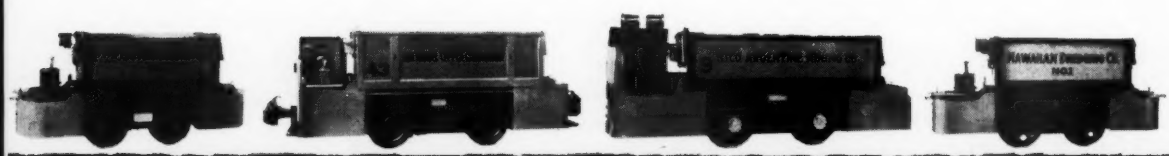


SERVING THE MINING INDUSTRY EVERYWHERE—
THE GREENSBURG DIVISION

MANUFACTURING, SELLING AND SERVICING
THE FAMOUS GREENSBURG LOCOMOTIVES



GREENSBURG MONITOR—a great name in mine locomotives—is now an integral division of NATIONAL MINE. The complete range of Greensburg Monitor Storage Battery Locomotives, from 2 to 15 tons, is backed by the service of National Mine in every major mining area. When you want *more pulling power per ton*, with longer battery life and higher efficiency for every invested dollar, check the facts with National Mine!



National Mine Service Company

KOPPERS BUILDING, PITTSBURGH 19, PA.

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National tailor-makes the coil to fit your application

These generator stator coils symbolize the full range of coil insulations offered by National Electric Coil. Since NATIONAL either *makes or uses all types* of insulation, our recommendations are based solely on the requirements of your application.

Here's the range of insulation systems NATIONAL offers:

- All Standard Class A, B, and H
- Silicone rubber
- Mica and glass combinations impregnated with catalytic type resins such as epoxies, polyesters and blends.
- Basic insulations impregnated with asphaltum.

You'll find it pays to deal with National.
Call or write for full information on our services.

National Electric Coil

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DIVISION OF McGRAW-EDISON COMPANY

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ELECTRICAL ENGINEERS • MANUFACTURERS OF ELECTRICAL COILS, INSULATION, LIFTING MAGNETS • REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

ANNOUNCING

the New Heavy Medium Cyclone Washer for fine coal, 3/4 inch to 48 mesh

Now available to coal producers in the United States

ROBERTS & SCHAEFER is proud to announce its appointment as exclusive representative in the United States for the famous Dutch States Mines Heavy Medium Cyclone Washer for fine coal, 3/4 inch to 48 mesh.

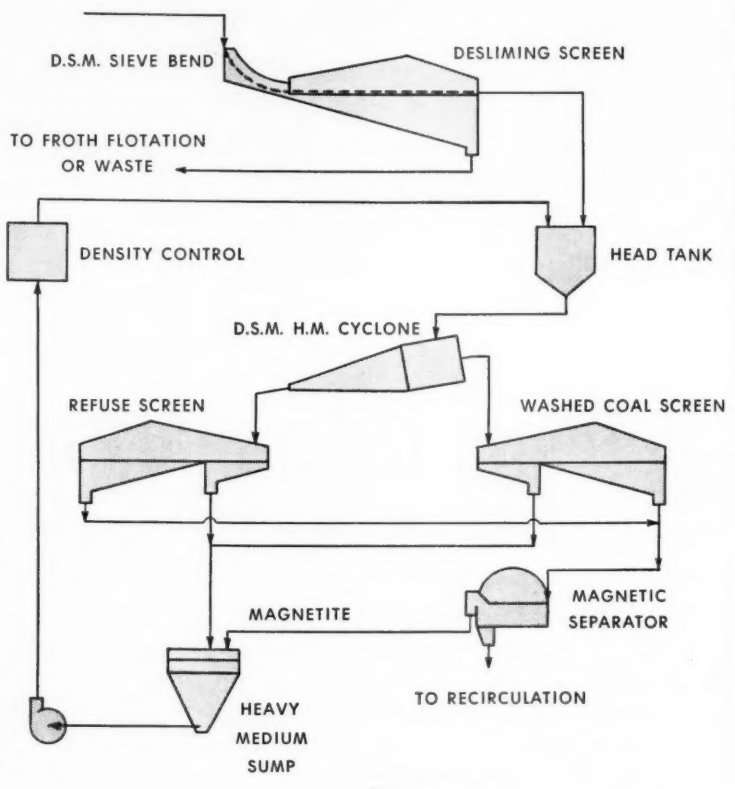
The completely new, heavy medium cyclone washing system will offer many coal producers unique opportunities to improve operations, increase yields of fine coal, reduce costs and deliver a better quality coal to their customers.

Another Exclusive for

ROBERTS & SCHAEFER

During the past 50 years, Roberts & Schaefer has pioneered many innovations in coal processing and cleaning methods and facilities. The new Dutch States Mines Heavy Medium Cyclone Washing System is another exclusive feature of the flexible and comprehensive service provided to the nation's coal mining industry by Roberts & Schaefer.

FLOW DIAGRAM OF DUTCH STATES MINES
HEAVY MEDIUM CYCLONE WASHING SYSTEM



WRITE, PHONE OR WIRE for information about the new Heavy Medium Cyclone Washer. Our engineers will be glad to discuss the application of this system to your present operations.

ENGINEERS & CONTRACTORS

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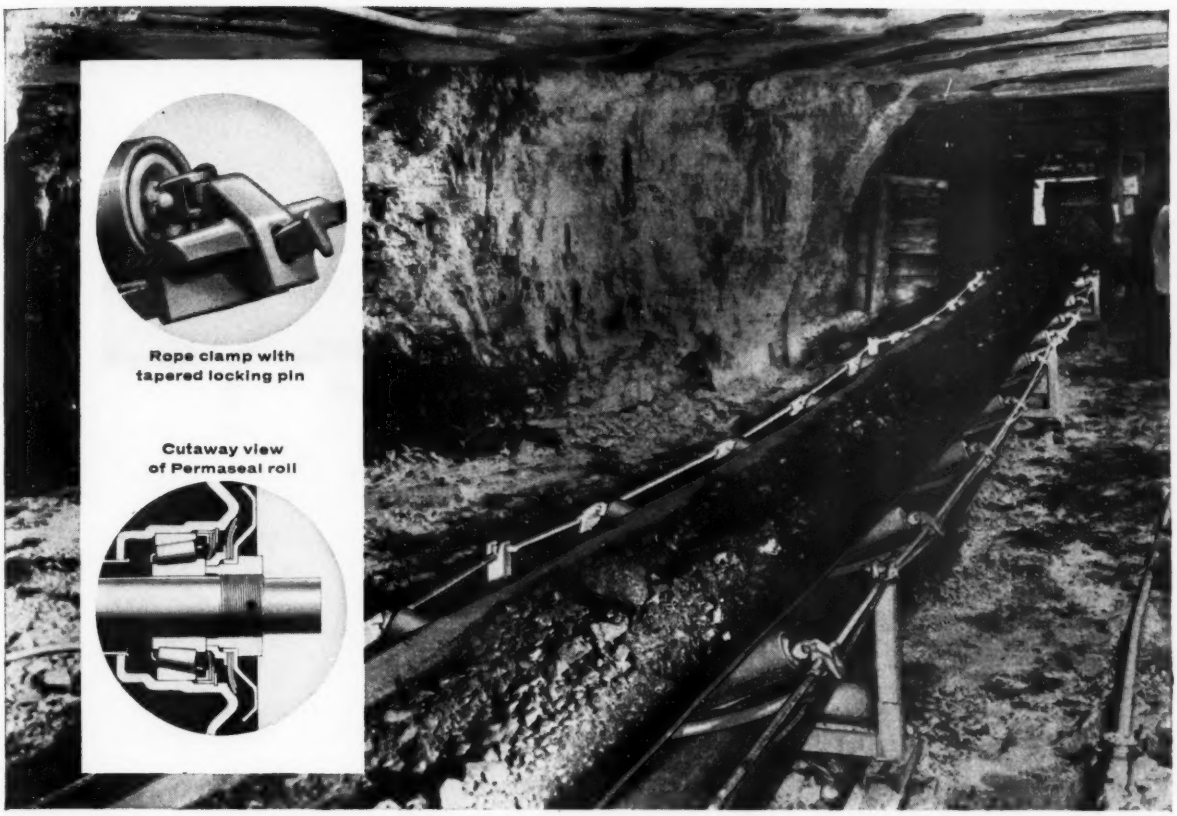

JEFFREY BELT CONVEYORS

(wire rope type)

have these advantages . . .

Low first cost—Easy and economical to set up with fewer parts; need no belt training idlers; intermediate sections require no cover plates; two parallel wire ropes replace heavy rigid type angles or channel side frames.

Low operating costs—Fewer components to handle or transport saves time in extending or retracting. Little or no spillage means less clean-up time.

Long belt life—Lasts longer as load impact is absorbed by spring effect of wire ropes when load passes over troughing idlers.

Permaseal idlers—Have Timken tapered roller bearings protected by two flexible diaphragm seals. Inner seal retains lubricant. Outer seal keeps out dirt. Prelubricated for years of maintenance-free service.

Spacing of idlers—Can be changed easily to suit material or mine conditions.

Rope clamp for cradle bracket—Rope clamps with "no loss" tapered locking pins prevent creeping. Cradle brackets and support stands hold ropes parallel. No separate spreader required.

Versatility—These conveyors can be used above or below ground to handle coal, salt, gypsum, iron ore, etc.

For more details send for bulletin 948. The Jeffrey Manufacturing Company, 958 North Fourth Street, Columbus 16, Ohio.

JEFFREY

MINING • CONVEYING • PROCESSING EQUIPMENT...TRANSMISSION MACHINERY...CONTRACT MANUFACTURING

(The) Standard of Comparison for HARDNESS AND TOUGHNESS

In performance tests by company after company, Sheffield Moly-Cop balls are used as the quality standard by which grinding balls of every make are measured. A big reason is the perfect balance of Moly-Cop hardness and toughness—unvarying to the core. This means a longer grind, fewer chargings, less down-time, and other production economies for you.

New steels are born at Armco

SHEFFIELD DIVISION

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ROLL SEVEN — EVERY PASS

Sevens pay off on the Iron Range, too, especially when made by a Marion 151-M.

This 7-yard machine continues to strengthen its reputation for steady, low-cost, dependable loading.

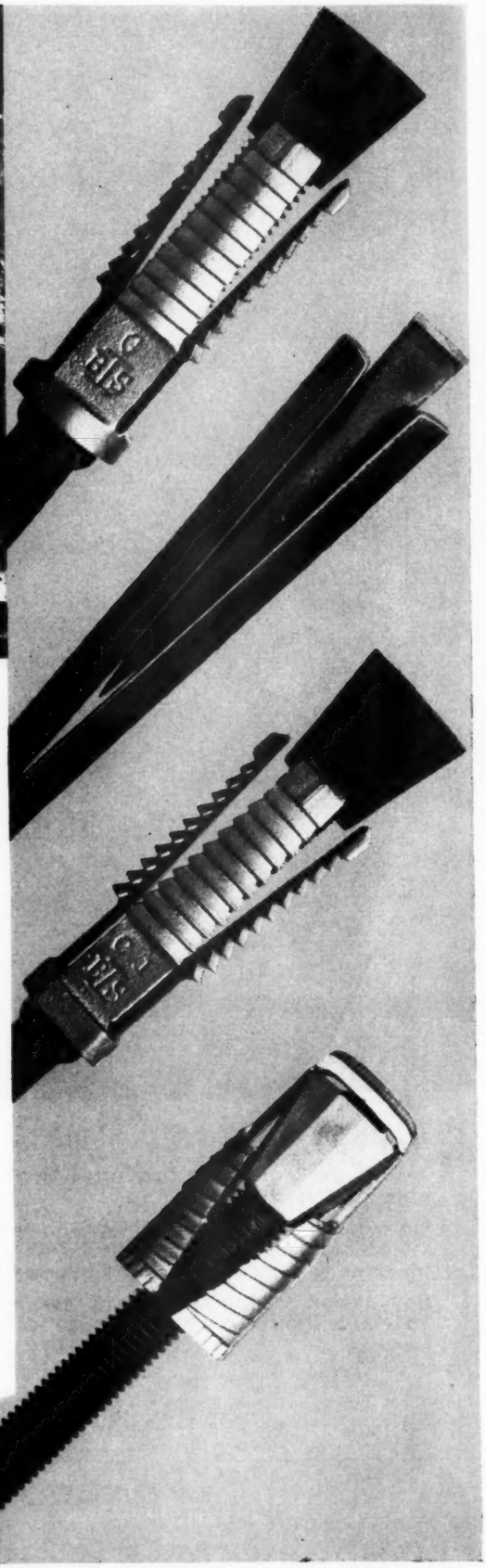
Here is stamina for the heaviest, hardest digging, with smooth, fast cycle time. Here is Ward-Leonard electric control with refinements that save on power costs and protect the machinery against shock and overload.

Let Marion mining specialists tell you about the work records being made in mining by the 151-M, and outline what it can do for you.

You get **MORE** *with* **MARION**

MARION POWER SHOVEL COMPANY • Marion, Ohio

A Division of Universal Marion Corporation



Thinking about bolting your roof? Remember that we offer more than proved bolts and accessories. Bethlehem contact men are available at all times to assist in installation and testing. Just call or write our nearest sales office. We'll do the rest.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Herringbone's two pairs of Lang lay strands and one pair of regular lay strands provide the ideal combination of maximum flexibility with good stability.

Finer wires inside contribute to Herringbone's excellent drum-winding characteristic.

Heavier outside wires in each strand have greater resistance to abrasion.

"...we would never hesitate to recommend it"

GRAY & FEAR, CONTRACTORS

This company continues: "We have been using your Roebling Herringbone* for about one year. We find it is one of the best ropes we have ever used, outlasting previous ropes three to one. It is good that such a reliable rope is available."

This is a direct field quote on the most remarkable development in wire rope in years . . . a new concept in wire rope design. Roebling Herringbone is the regular lay and Lang lay wire rope —two-ropes-in-one rope—combining the best features of both.

Herringbone delivers extra flexibility, extra abrasion resistance, unusual structural stability, extra resistance to shock, easy operation over sheaves and drums and smooth spooling properties.

We recommend Herringbone without reservation for general hoisting and the entire range of heavy-duty equipment. Your Roebling Distributor or Wire Rope Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey, will give the full and fabulous details. *Reg. App. For

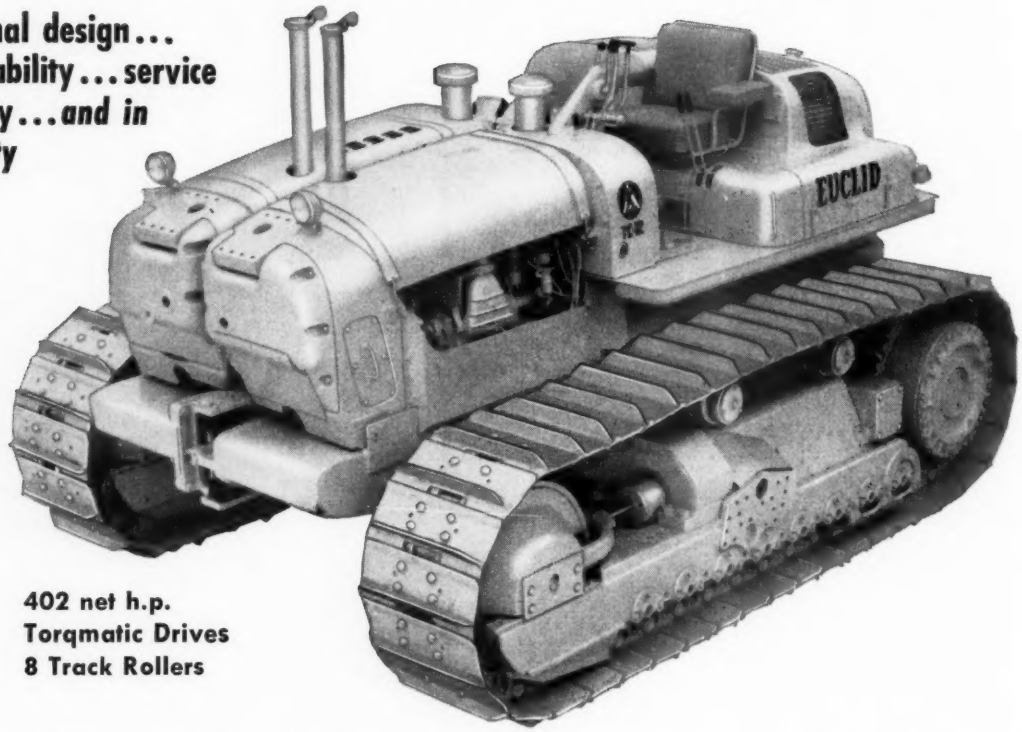
ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

New Series *Euclid TC-12* . . .

now even further ahead of other crawlers

in functional design . . . maneuverability . . . service accessibility . . . *and in work-ability*



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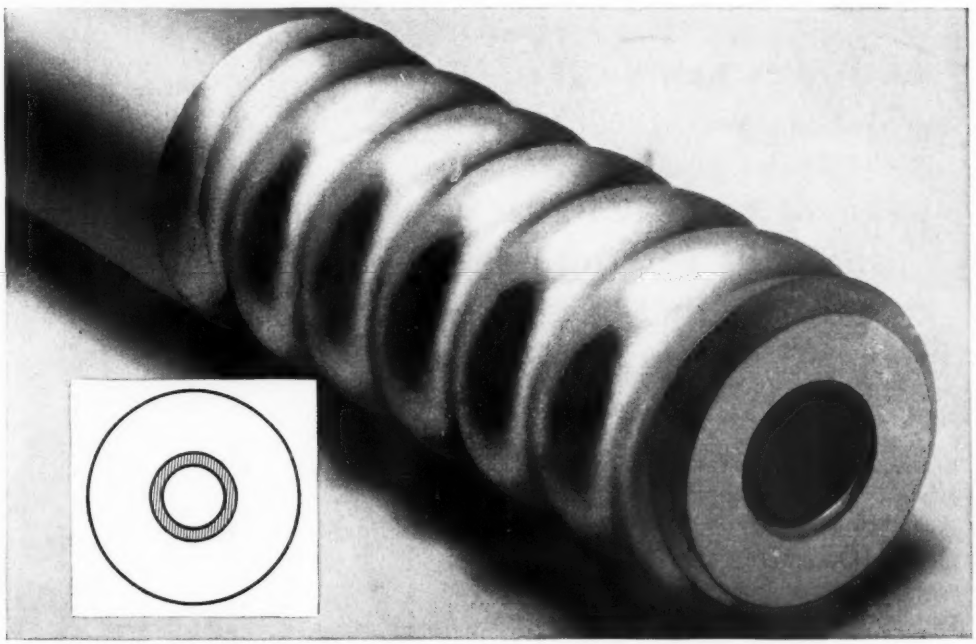

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EDITORIALS

ROBERT W. VAN EVERA, Editor

MARCH, 1959

A Fetish Indeed

President Eisenhower has been accused of making a "fetish" of balancing the budget. The inference is that no particular reason exists for our nation to accept the "hardship" of living within its means.

Now we would class those who want to be relieved of any actual or moral obligation to balance the budget as being truly "liberal"—liberal, that is, with other people's money, particularly the money of widows, pensioners, our children and our children's children.

At the risk of appearing at least thirty years out of date, we observe that almost no one in modern times thinks in terms of a *repayment* of any part of the national debt. The president might have proposed a schedule to pay up our creditors during these prosperous times—as honest individuals are expected to do. But the public apparently doesn't mind shelling out nearly eight billion dollars in interest this year—and more as the debt climbs—to buy nothing whatever to improve the nation's well-being.

After all, what's a mere EIGHT BILLION DOLLARS per year compared with the pleasure of letting ourselves get soft and decadent by borrowing on the earnings of future generations?

Research for Higher Efficiency In Power Plants

The U. S. Bureau of Mines is preparing to conduct research and development to establish the feasibility of the coal-burning gas turbine for power generation in stationary plants. Coal-fired gas turbine plants for motive power use have been the object of more than twelve years of detailed study by Bituminous Coal Research, Inc., and all of this work is available to the Bureau of Mines, who will proceed to adapt it to applications in stationary plants.

BCR has come up with solutions to three basic problems which existed at the beginning of its project: 1) feeding coal to the combustion chamber at elevated pressures, 2) burning coal at high temperatures and pressures, and 3) ash control and elimination. Marling J. Ankeny, Director of the Bureau, has stated that his agency will seek even better fly ash control than has already been developed, and will work toward improving the design of turbine blades and developing better materials of construction.

By eliminating the need to develop steam for driving turbines, this research becomes particularly attractive for producing cheap power in our western arid regions and in similar areas through the world.

This is a case where research investments can pay large dividends in benefits to the coal mining industry as well as in raising the American standard of living with low-cost electric power.

Nickel Supplies Assured

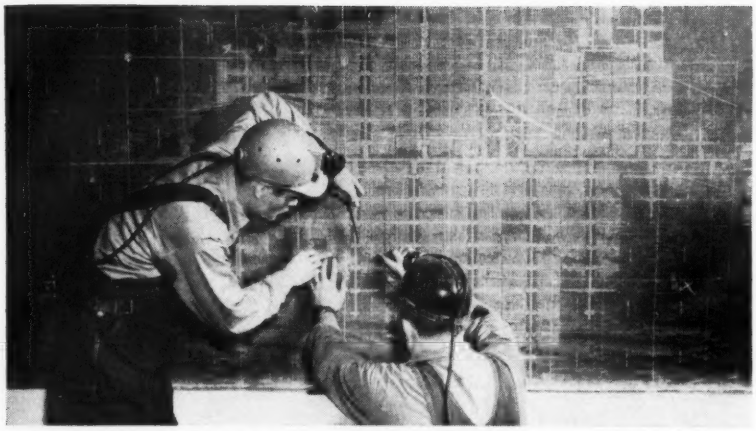
Those who studied the review of "Nickel" by Henry S. Wingate, President of the International Nickel Company of Canada, Limited, in the Annual Review issue of MINING CONGRESS JOURNAL are fully aware that recent expansions of production facilities now assure consumers an adequate and uninterrupted supply of the metal for the future.

Actually, it has been a long time since we have experienced any real shortage of nickel. But the wartime restrictions of fifteen to twenty years ago emphasized the metal's importance in many alloys that we normally take for granted.

The nickel industry's problem has switched from one of maintaining adequate output, to one of developing markets for the now plentiful supply. Although we fully appreciate the marketing problem confronting the industry, we feel that a tribute is due the many men whose fine work has solved the supply problem. These efforts have not been confined to one company—Inco, Hanna, Freeport Sulphur and others have made important contributions in expanding nickel producing capacity.

In this issue, page 39, appears the first part of the article, "Exploration Procedure at Inco," inspired by the remarkable accomplishments of International Nickel's geological department in developing large new reserves of nickel ore in the Mystery-Moak Lake area of Manitoba. We recommend it to all mining men.

PLANNING for Continuous Mining



It is necessary to know what to expect from plans being executed in order to evaluate performance

Thorough planning by all members of management means greater productivity

By JESSE F. CORE

Vice President—Operations—Coal
U. S. Steel Corp.

PLANNING is a phase of any operation, mining or otherwise, which must be given full consideration by all members of management. A real operating plan is not just a mine projection. Careful inception of a mining plan entails objective cooperation by competent mining engineers, industrial engineers or their counterparts, safety inspectors, accountants, and alert, progressive operating personnel. The end result of such cooperative effort must be a detailed layout incorporating sound engineering, efficient operating practices, improved working conditions, particularly with respect to safety, and presented in such a manner as to be perfectly understandable to the face supervisor who must properly execute the plan in order to attain the projected production and cost. After all, there is an ultimate return which can be expected from any given plan. Without the sort of planning outlined here, how can performance be measured? It is necessary to know what to expect from the plans being executed and without such knowledge evaluation of performance is impossible.

It goes without saying, no plan is perfect. Accordingly, there must be a never-ending search for improvement. However, upon final completion and approval of any one plan, objective execution is the next step. After assuring themselves that the particular foremen involved are entirely familiar with the operating requirements of the plan, top mine management must insist upon the strictest possible compliance in all respects. Experience indicates that in most instances failure to attain production and cost objectives can often be tied directly to deviation from established plans.

Establishment of thorough plans and proper execution of same are not accomplished overnight. The actual case which will be described has run the course of careful planning and objective execution with constant searching for improved methods.

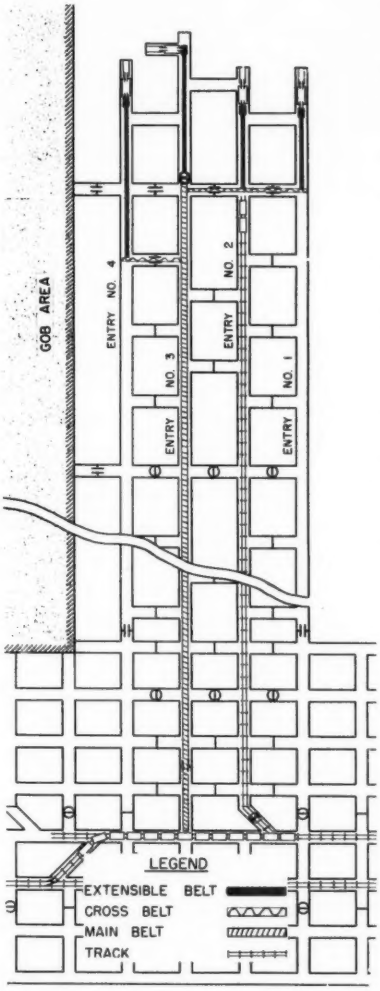
Advantages of Continuous Mining

Since 1920 coal operators and equipment manufacturers have been designing, building and perfecting continuous mining equipment. Although not always as continuous as the name implies, the machine cuts and loads the coal in one operation without drilling and blasting.

Along with the elimination of these two basic operations in the mining cycle, other elements to improve pro-

ductivity and safety were visualized:

1. **Accidents would be reduced at the face because fewer working places would be necessary, resulting in closer supervision.**
2. **The hazards of shooting, such as handling of explosives, ignitions, and dangers of flying objects, would be eliminated.**
3. **Improved roof conditions could be expected with the elimination of blasting.**
4. **Fewer men would be needed to produce a given tonnage.**
5. **Fewer working faces would have to be maintained and serviced.**
6. **The shortened time of roof exposure as a result of rapid mining rates should reduce roof falls.**
7. **Better over-all recovery could be expected with better roof conditions.**



Four entries are driven on development by four equipment units which consist of a continuous mining machine, a shuttle car and an extensible belt. Only two of these units are worked on each shift, freeing the other two for maintenance. Equipment from either of the two idle units is pressed into service should there be a breakdown on the working units

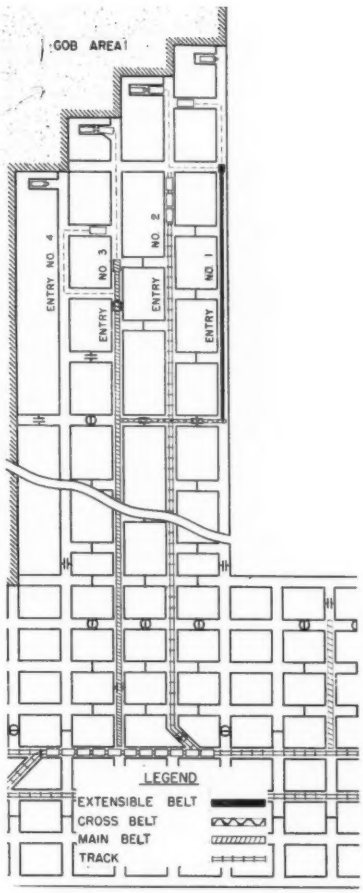
The advent of continuous machines has produced varied mining systems. This article deals with the design of one particular system utilizing four machines in four entries, and is referred to as a four-unit panel.

Development

The equipment assigned to each entry of the development plan for a four-unit panel consists of a continuous mining machine, shuttle car and extensible belt. Four units are used to drive the four entries on 85-ft centers to a maximum depth of 4000 ft. Crosscuts are on 104-ft centers and staggered as much as possible to attain maximum roof control. Because no extensible belt is designed to extend 4000 ft, cross belts receive the coal from the extensible belts and transfer it to the main belt. The cross belts are advanced and installed at established intervals so as not to exceed a predetermined length of the extensible belt. The extensible belt in No. 3 entry discharges directly onto the main belt which transfers the coal into mine cars. Two units work on each operating shift, leaving the other two units as stand-by spares and for repair and maintenance.

On straight entry work, the continuous mining machine, shuttle car, extensible belt and entry belt act as one unit to obtain a continuous flow of coal from the face to the mine car. While driving crosscuts the continuous flow is broken when the depth exceeds the length of the continuous mining machine plus the shuttle car and, consequently, the shuttle car must tram. A continuous flow of coal could be maintained by shortening the crosscut distance. This reduced center would cut the area of the block to one-half that of the block presently used. This is not desirable, because heavy cover causes excessive bottom heaving when the area of the block is below a certain minimum. The bottom heaving would not only prove difficult in keeping the belts aligned, but would necessitate bottom grading to maintain sufficient clearance for tramming equipment. For this reason, the small block size was eliminated.

According to plan, every fourth set of crosscuts is in line. This distance of approximately 400 ft is the multiple of the cross belt moves. The distance was designed to limit the length of the extensible belts to 700 ft, yet permit scheduling of the cross belt moves to the most opportune shift. The advance of the cross belts is accomplished by tramming the headpiece of the extensible belt or belts to beyond the next cross belt location. After the extensible belts are in place, the cross belt is trammed along the open entry and installed in the new location. The extensible belts are then spotted to dump properly onto the cross belt and the belts are again



Because it is necessary to remove machinery as soon as a place starts to work, only one extensible belt is used when a section is on the retreat. In order to minimize interruptions to the continuous mining machines, a second shuttle car or a surge loader is used behind each

ready for operation. Only one side, or at the most, two extensible belts are out of operation at one time. That is, either the extensibles in No. 1 and 2 entries, and the cross belt connecting them, or the extensible in No. 4 entry and the cross belt connecting it, are advanced at one time. This provides at least two working faces at all times.

The main belt in No. 3 entry is advanced without affecting the operating time. This job must be done at least every other day so that the belt crew can accomplish the necessary work in the allotted time. A crew of five men handle all the belt moves.

A supply track is installed in No. 2 entry on which the material cars are spotted out by the cross belt. The supplies are manually wheeled to the faces. The original intention was to transport the supplies to the faces by reversing the extensible belts;

however, excessive belt maintenance more than offset the advantage of this method.

Extraction-Wing and Pocket System Used

In the extraction of pillars, the nature of the roof necessitates a change in plan, it being necessary to remove machinery as soon as a place starts working.

Hence, the extensible belt in No. 2, 3 and 4 entries are removed. The extensible belt in No. 1 entry serves the shuttle cars on the right side.

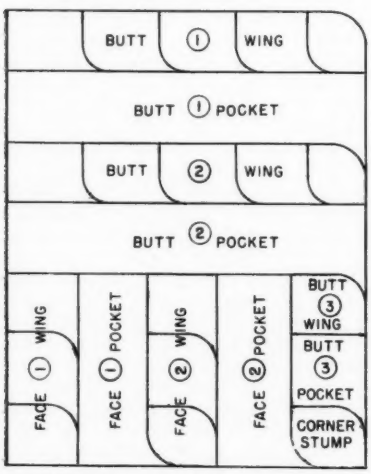
In order to minimize interruptions to the continuous mining machine, a second shuttle car or a surge loader is employed.

Elimination of one cross belt in the extraction plan not only lessens the belt work, but permits "leap frogging" the installation of the cross belts and, now, when repositioning the extensible belt in No. 1 entry, only the headpiece need be retreated and the belt is again in operation.

The main belt is removed in increments of one block length.

Supply track in No. 2 entry is maintained to the tailpiece of the extensible belt where the material cars are spotted and the supplies transported to the working faces in shuttle cars.

The wing and pocket system is employed on block extraction. Basically, two butt lifts are extracted first, then two face lifts, next a butt lift, and finally the corner stump is extracted to complete the block. The pockets are driven 14 to 15 ft wide leaving a 12-ft wing. Before a wing is extracted, a 12-ft push block is marked off and the remainder of the wing divided into passes not exceeding 15 ft. All of the wing is extracted.



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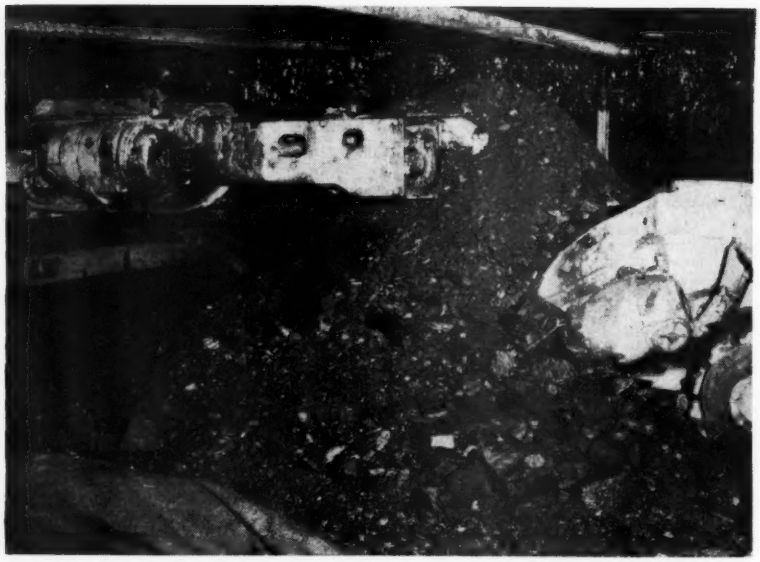


The rapid advance and retreat of continuous mining machines emphasizes the importance of concentrating face areas whenever possible

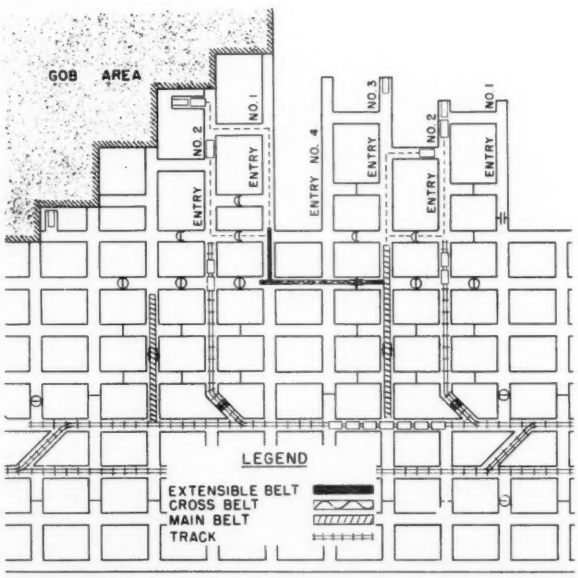
A full block step is maintained between each pillar to attain maximum roof control and maximum utilization of belt moves. Sequence prints are issued to each section foreman to insure this step as well as the sequence of block extraction. Maximum shuttle car hauls under this system are limited to 400 ft.

Transition from Extraction to Development

The transition from extraction to development requires that a spare main belt be installed in the adjoining panel next to be worked. A spare cross belt is extended from this belt to No. 1 entry of the present panel. The next move of the extensible belt in the present panel is to discharge onto this cross belt. When this move is made, the operation of the main belt in the present panel is discontinued and the main belt in the adjoining panel is used to transfer the coal into mine cars.

Two continuous machines are moved to the adjoining panel where they are utilized to develop enough of the next panel to permit installation of the initial facilities.

Two machines complete the extraction in the present panel, at which



The transition from extraction to development requires that a spare main belt be installed in the adjoining panel next to be worked and a spare cross belt extended from this belt to No. 1 entry of the retreating panel

time, all machines are placed to develop the adjoining panel and the belt system installed as initially described.

Ventilation

The ventilation plan of the panel on development shows that three rows of prefab steel stoppings separate all entries. The intake air is conducted in No. 2 entry, split at the faces and returned in No. 1 and 4 entries. This method of ventilation provides a separate split of air for each operating unit. The row of stoppings between No. 2 and 3 entries maintain a neutral split of air over the main belt. This air is not permitted to be used for face ventilation, but routed directly into the return in No. 4 entry. Openings are driven into the gob area every 400 or 500 ft to bleed the gob, thus keeping the area free of gas accumulation.

An emergency door is constructed in the track entry so that, in case of fire in this entry, this door can be closed, shutting off the air into the section and permitting the workmen to escape in the belt entry. In case of fire in the belt entry, no ventilation change is necessary because the track entry provides the route of escape.

To fight a fire, a four-in. steel water line is laid along the belt in No. 3 entry. Fire hose connections are installed at intervals of not more than 500 ft. Sufficient 2½-in. fire hose to reach 500 ft is stored at each location.

The four-in. line is also used for sprinkling water to control the dust at the faces.

The plan of ventilation on extraction is the same as that used on development except now 30 to 40 percent of the air is pulled over the gob into the bleeders maintained at the back of the panel. Returns are still maintained on the right and left hand sides of the panel to insure positive ventilation and the main belt is still on a neutral split of air.

Eight-Man Crew

Face manning for each operating unit, whether on development or extraction, consists of eight men. On development, the crew is made up of one continuous mining machine operator, one shuttle car operator, one belt man, two roof bolters and three utility men. The shuttle car operator advances the shuttle car and extensible belt. The belt man installs the line brattice and does the necessary clean-up along the belt. The shuttle car operator and belt men team together to advance the extensible belt. The three utility men bring up supplies, rock dust, advance cable and hose, and reposition the equipment for the straight advance after the crosscut is driven.

Machine repairmen are scheduled onto the section as required from the maintenance force at the mine.

The only change in manning from development to extraction is the substituting of a shuttle car operator or loader operator for the belt man.

Conclusion

In conclusion, the writer wishes to again enumerate some of the factors that are necessary for the success of any mining plan. These factors become more critical and should be given more emphasis with the rapid advance and retreat of continuous mining machines. The factors are:

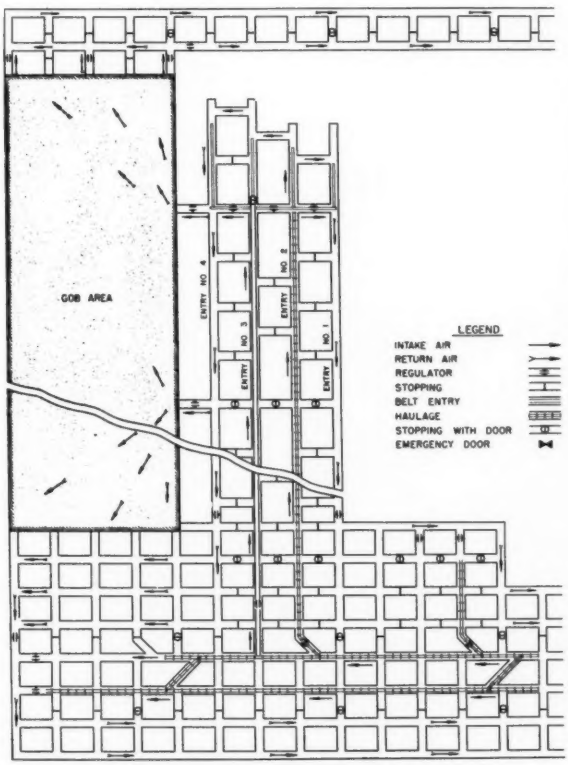
(1) Concentrate face areas whenever possible.

(2) Prepare carefully worked out mining plans.

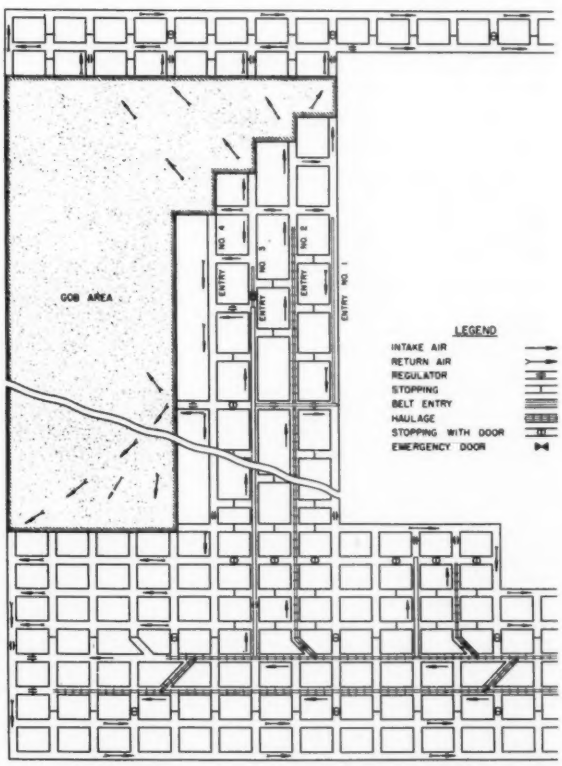
(3) Focus the attention of mine management on improving face procedures.

(4) Train section foremen in all details of face procedures to receive the maximum benefits.

(5) Train all contract employees on the section to the degree necessary for efficient execution of the operating plan.



When on development, intake air is conducted up No. 2 entry, split at the faces and returned in No. 1 and 4 entries. Note that openings are driven into the gob area every 400 to 500 ft to bleed the gob

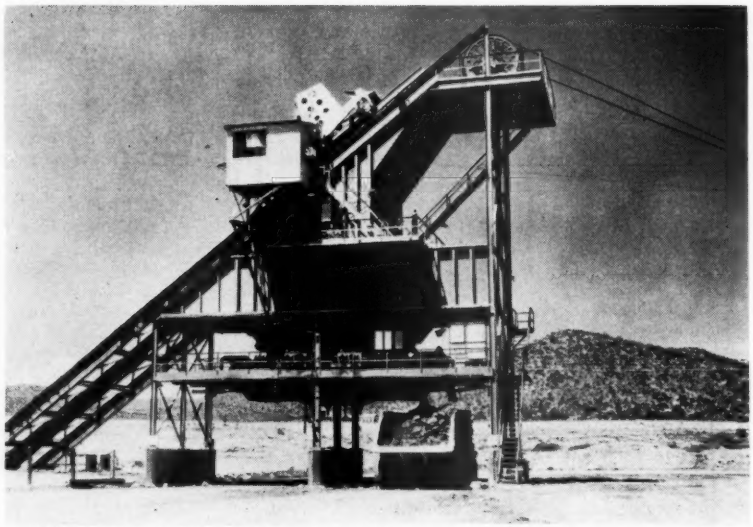


The plan of ventilation on extraction is the same as that used on development except that 30 to 40 percent of the air is pulled over the gob into bleeders maintained at the back of the panel

INCLINED SKIP for Open Pit Hoisting

Pima's truck-skip layout required a somewhat larger initial investment compared to an all truck haulage arrangement, but substantial savings have been realized by making it unnecessary to build a direct haul road out of the pit

By E. D. SPAULDING
Resident Manager
Pima Mining Co.



Although the original installation has required some costly modifications, company officials feel that the combination truck-skip system is the most economical method of transporting material for their operation

AT least four or more mines on the Iron Range have transported material successfully from open pits with skip systems incorporating an inclined railroad and a hoist to lift the cars. The one installed at the Pima mine near Tucson, Ariz., is the only skip system in actual operation in the Southwest. At least two others are contemplated or are in the construction stage now.

In this article, the author will outline why Pima Mining Co. selected this system of transporting material from its open pit.

The transportation of material, using trucks, is the highest cost item in open pit mining. Mining equipment is selected to accomplish a job in the most practical and economical manner. In choosing equipment, the peculiarities or special characteristics of the deposit to be mined are major factors in determining the choice.

Pima's Pit Has Topographic Disadvantages

For example, with the exception of the Ajo and Lavender pits, the Pima mine is the only pit in production in Arizona which started on comparatively flat or moderate topography. Other Arizona ore bodies being mined are located in rugged areas where some advantage of the terrain can be taken in transporting material and disposing of waste.

Besides the topographic advantages, most of these ore bodies being mined as open pits are classified loosely as disseminated or porphyry deposits. They may be irregular, but in general the horizontal axis is longer than the vertical axis. The ore body at Pima is not of this shape. It is small and narrow; its width is quite variable but will average about 200 feet. Its present development shows a lateral extent of approximately 1800 feet dipping at an angle of approximately 45 degrees to the south, with the rock sub-outcrop covered by 200 feet of alluvium or desert detritus.

No Direct Haul Road Needed— Saves $1,710,000

Other factors were considered when choosing the method of transportation — capital investment and the addi-

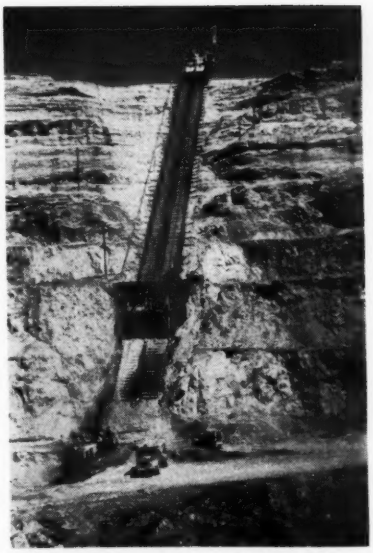
tional volume required to be removed to lay out an adequate road system for complete truck haulage at an eight percent grade.

An expenditure of $1,075,000 for a fleet of 25 trucks (using an operating fleet of 20 units) would have been required for the installation of a complete truck haulage system. For a combination skip-truck system, an investment of $1,244,000 was required. This outlay consisted of the skip installation, ten 22-ton trucks, and four 50-ton trucks. The difference in initial investment was not substantial; and with the savings in transportation cost, the higher investment of $169,000 in the skip system will be repaid during the life of the orebody. The substantial saving is in the elimination of a direct haul road out of the pit. It is estimated that it would require the movement of 3,200,000 additional yards at a cost of $1,710,000.

Before making a decision on the method to be used in removing material from the Pima pit, a thorough study was made of the operations then in existence on the Iron Range. This information led us to believe that a combination truck haulage and skip system would give:

1. Low maintenance cost
2. Low operating cost
3. Reduction in haulage road maintenance
4. Low investment in spare parts and standby equipment
5. Minimum stripping required for haul systems
6. Decreased maintenance for trucks
7. A minimum yardage required to be excavated because of the need for only limited access roads to the pits

Some of these points proved to be true and some did not. Operating costs have not been completely satisfactory, but the necessity of making a considerable number of construction revisions to the skip system caused this increased cost. The system has been operating since April 1957, and at this writing the company believes that the major portion of reconstruction has been accomplished and operating costs will now more nearly reflect estimated costs.



The structure of the ore body at Pima is unlike that of typical porphyry copper deposits; it is small, narrow and has a 45-degree dip. These characteristics make skip hoisting advantageous

The material which is handled in the copper pits of the Southwest and Far West is completely dissimilar to that handled on the Iron Range where the skip system was originally developed. Experience has shown that although the specific gravity of the material on the Range is higher, it breaks finer. The larger size of the Western material, with a resultant higher force of impact, has disastrous effects upon the structural members and surfaces.

The principal reconstruction was done at the points of impact of material upon the steel surfaces. At these points the shock was cushioned by backing the steel plate with rubber, constructing rock boxes, or developing a muck pad. T-1 plate was substituted for AR or mild steel plate. With these revisions, excessive maintenance has been reduced to a workable minimum.

Operating Costs Slightly Higher Than Expected

Preliminary estimates indicated that operating costs for a complete truck haulage system from the pit to the primary crusher would be $0.240 per ton of material. It was estimated that the cost of a combination truck and skip system would be $0.1638 per ton.

Skip	**$0.0193 per ton**
Trucks, 802's in pit	**0.0945 per ton**
Trucks, 802B's on surface	**0.050 per ton**
TOTAL	**$0.1638 per ton**

Actual cost for the first half of 1958 was found to be $0.2045 per ton.

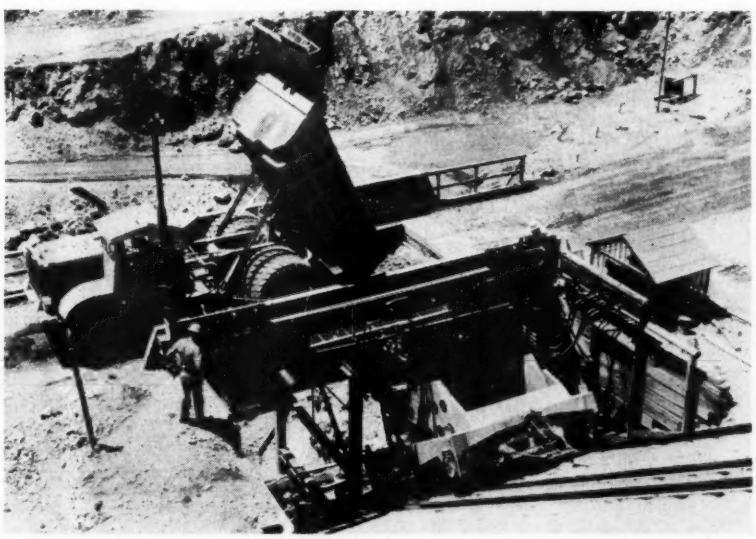
Skip	**$0.0565 per ton**
Trucks, 802's in pit	**0.0971 per ton**
Trucks, 802B's on surface	**0.0509 per ton**
TOTAL	**$0.2045 per ton**

It is apparent that original estimates for the skip operation were low. Unit cost for the period it operated during 1957 were higher because: (1) considerable expense was incurred in repairs and reconstruction; and (2) the skip was not operated efficiently because of delays in the pit, with resulting low tonnage.

Management now considers skip operating costs to be about normal, although they will increase slightly as the pit deepens. At present, the pit is 400 feet deep (2950 level) and is designed to go to 640 feet (2710 level). Experience has shown that any substantial increase in cost above what may be considered normal will be found in repairs of skip cars, driveover structures, bins and feeders — and not in the mechanics of hoisting.

Although reconditioning and revamping the skip system has been somewhat costly, it is sincerely felt that the combination truck-skip system is the most economical method of transporting material from a pit such as Pima's.

The author wishes to express his appreciation to James Olk, chief engineer and R. E. Thurmond, mine superintendent, for their help in preparing this article.



Experience has shown that any substantial increase in cost above what may be considered normal will be found in repairs of skip cars, driveover structures, bins and feeders—not in the mechanics of hoisting

Green Diamond's preparation plant processes 525 tph. Inset shows crawler-mounted tractor bulldozing coal from stockpile into glory hole leading to slope belt. Coal is stockpiled on the night shift and fed back onto the slope conveyor on the day shift when plant is operating

Green Diamond Mine

By GLENN F. JACKSON

Twenty-six tons per payroll man sums up the success story of one of Illinois' most progressive deep coal operations

A 15-man crew on August 24, 1950, loaded 1482 tons of coal in one shift at the Green Diamond Mine near Marrisa, Ill. This feat was accomplished with one loading machine and two shuttle cars in room-and-pillar mining. Although the record still stands, the mine has consistently displayed over the years a high degree of efficiency and is today averaging 26 tons per man of clean coal (includes both surface and underground personnel).

Success did not occur by chance but took careful planning and considerable ingenuity on the part of management to overcome poor roof conditions, faults and many other problems in developing a high speed operation. The purpose of this article is to present a brief over-all picture of the Green Diamond Mine, with emphasis on some of the methods used to speed production without neglecting safety.

3500 TPD of Clean Coal Produced

Opened in 1949, Green Diamond produces 3500 tpd of clean coal, employs 128 men and is operated by the Mid-Continent Coal Corp., a subsidiary of Snow Hill Coal Corp. W. S. Webster is president of Mid-Continent, A. G. Gossard, vice president, and Arthur S. Macke, vice president and general manager. At the mine, M. O. Barber serves as mine manager and Floyd Macke as chief engineer.

The company employs a room-and-pillar system and conventional mining equipment. Coal mined at the face is loaded into shuttle cars and thence onto belts for its journey to the modern cleaning plant on the surface. All equipment is portable—either rubber-tired or skid-mounted—to facilitate the numerous moves necessary in a high speed coal operation. Most underground equipment is d-c and is generally repaired and overhauled in a large underground shop.

Reserves Estimated at 75,000,000 Tons

Let us examine seam conditions, mining plan, equipment and operational practices in some detail to see what has enabled the mine to achieve its high efficiency and excellent safety record.

Green Diamond was opened by a 300-ft slope and a 90-ft shaft into the Illinois No. 6 coal bed, which averages 84 in. in thickness. The rolling seam pitches to the north about one percent and contains some faults, one of which caused a 20-ft separation of the coal. Reserves are estimated at 75,000,000 tons.

Cover varies between 100 and 250 ft and consists of approximately 60 percent shale and 40 percent limestone. The roof is weak and, if conventional timbering methods were used, would require crossbars "skin

to skin" in most places. Roof bolting has played a key part in the successful mining of the seam and, according to the management, has permitted the recovery of much coal that otherwise would have ben uneconomical.

The fireclay bottom has presented few problems because the mine is essentially dry. However, the uneven floor is hard on haulage equipment. Management is considering purchasing an electric bulldozer, which would be used to grade main haulageways in a move to speed transportaion and lower maintenance costs of haulage units.

Pillars Not Recovered

A conventional room-and-pillar method is employed, but pillars are not recovered. All entries, rooms and crosscuts are on 60-ft centers. Entries are 18-ft wide, crosscuts 20-ft wide and rooms 24-ft wide. Seven entries are driven in each panel. The panel belt is installed in the center entry, and room belts are placed on 600-ft centers on both sides of the entries (see accompanying map).

There are two working sections, both double shifted. Because the tipple operates on the day shift only, coal produced on the second shift is stockpiled on the surface. A 40-ft diameter glory hole and variable speed vibrator feed the stockpile back onto the slope belt during the day as conditions permit.

On the two production shifts, a 15-man crew, including the face boss, is employed on each section. A six-man crew is used on the third shift for moving, extending belts, maintenance, rockdusting and other non-production jobs.

Off-Track Equipment Employed

The two working sections are equipped with off-track units. Face preparation and loading are done on the same shift, and the men are staggered through the lunch hour to insure a continuous flow of coal to the tipple. A typical list of equipment on a section would include:

(1) Two 11 BU loaders. Only one is used, the other acting as a spare.

(2) One 10 RU cutting machine. In addition, the mine has a spare unit that can be quickly sent to either section in case of a breakdown.

(3) A rubber-tired CD 26 coal drill. This machine is a self-propelled drilling unit equipped with two drills.

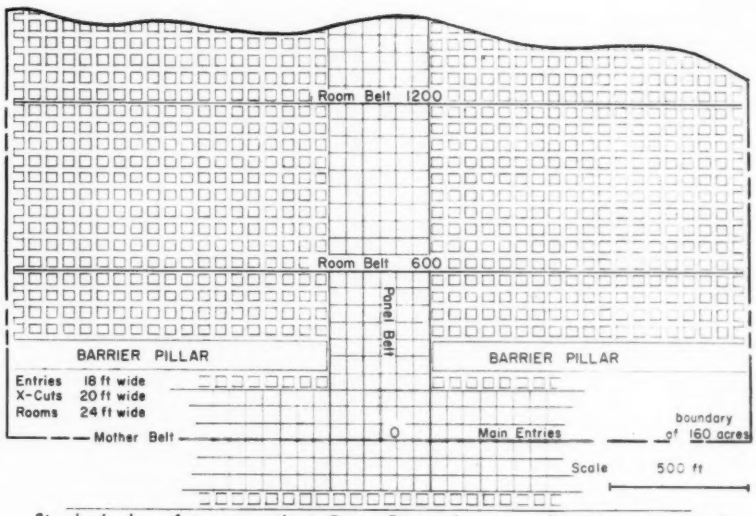
(4) One roof bolting machine. It consists of a rubber-tired CD 26 chassis with CD 25 hydraulic drills mounted on arms for roof bolting purposes.

(5) Three 60E shuttle cars. A spare or fourth unit permits repairing and overhauling shuttle cars without cutting a section's haulage capacity.

(6) One portable rock dust machine for each section plus one spare. The duster is carried in a shuttle car together with necessary rock dust when in use. It is interesting to note that the rapid advance of the working faces requires that they be rock dusted every workday.

(7) Necessary Airdox equipment for blasting.

All of the face equipment is d-c.



Standard plan of room panel at Green Diamond mine. All entries, rooms and crosscuts are on 60-ft centers

Face preparation and loading operations vary somewhat but may be described as follows. Two men operate the 10 RU, using water to allay the dust. Faces are bottom cut. One important change made on the cutting machines since their purchase should be noted. The mine has installed a bugduster. Mounted at the foot of the cutter bar, it is an eight-in. diameter screw-type conveyor. The device is driven off the same bevel gear that operates the cutter chain; hence, the conveyor's speed varies automatically with the speed of the cutter chain. The installation has proved effective.

Two operators, using a rubber-tired CD 26 drill unit and three-in. augers, drill 18 holes per face. An atomizer which sprays a fine mist of water has been tested on one machine in an effort to determine its effectiveness in keeping dust down. The success of this device has encouraged management to plan equipping other drills with similar units. Future plans call for the replacement of the CD 26 machines with CD 43 drills which can be operated by one man. The two drills on the CD 43 are mounted on remote control booms and use eight-ft augers. The unit positions the arms automatically and it is not necessary to spot holes to be drilled.

Coal is blasted with Airdox. This method utilizes the rapid expansion of compressed air to break down the coal and without the hazard of fire or release of noxious or toxic gases. Generally *two* holes are shot at a time. Four compressors on the surface — used in conjunction with the Airdox system — supply compressed air to the working faces through high pressure pipelines at pressures around 12,000 psi. Only three compressors operate at any one time, the fourth serving as a stand-by. The compressors alternate automatically, and, if one stops for any reason, the auxiliary automatically cuts into the system.

The heart of Green Diamond's mechanized operation is the loading

Up to 450 eight-ft holes are drilled per shift by each drilling crew

machine, and management is constantly striving to increase its loading time. Three cable-type shuttle cars and an 11 BU loader keep the face preparation equipment moving to stay ahead. Water is used to allay the dust and a staggered lunch hour keeps the coal flowing to the tipple. As previously mentioned, there is a spare loader on each section. By changing loaders during the shift, greasing and appropriate maintenance may be taken care of by the mechanic. The operator often uses one loader for one side of the section and the spare unit for the other half to minimize moving time.

Company Recovers 90 Percent of Roof Bolts

The modern technique of roof bolting at Green Diamond provides a firm, safe roof with the additional advantage of permitting the unobstructed movement of mining machinery. Each section uses a converted roof bolting machine that requires an operator and a helper. Bolts, ¾-in. in diameter and varying in length from 18 in. to 6 ft., with expansion shells are placed on four-foot centers —closer if conditions warrant. Wooden plates, used as washers in temporary work such as rooms, are 18 by 6 by 3 in. For more permanent installations, 6 by 6 in. steel plates are employed. Approximately 840 bolts are installed each workday and are tightened to 150 ft lb of torque.

The company strives for 90 percent recovery in its bolt recovery program. Two men, together with a battery-operated shuttle car, are used to recover 250-300 bolts per manshift. Four men may be utilized if the work gets behind. Bolts are taken to the inside shop at the end of the shift where they are cleaned, oiled and stacked for reuse. A portable machine equipped with wire brushes is used for the cleaning operation.

Shooting with Airdox and employing roof bolts has minimized roof trouble

Experience at Green Diamond has shown that the length of time bolts are left in the roof, presence of water and, of course, roof conditions are factors in determining the ease of bolt recovery. Management stresses the importance of recovering bolts as soon as possible.

Belts Protected With Numerous Safety Devices

Continuous haulage is a key factor in today's modern coal mines. Realizing this, management at the Green Diamond operation decided to use belts for main line haulage. Shuttle cars on each section unload on the panel belt which in turn dumps onto the mother belt that takes the coal to the preparation plant on the surface. Room, panel and mother belts are 36-in. wide and the slope belt is 42-in. Belt motors include 50 hp d-c units, a 75-hp a-c, and one 100-hp a-c employed on the slope. Spare motors of all sizes are available. Belt speed is 400 fpm.

Safety devices include: alignment switches which stop the conveyor if the belt runs off, automatic control switches which prevent pile-ups, finger switches to control the height and width of the load (rake-like devices which limit size of lumps), and centrifugal switches (load and motion devices) which stop a belt if the one ahead stops. The centrifugal switch provides slippage control; if the belt stops and the motor keeps running, the switch stops the motor.

The company's method of moving and extending belts has been simplified as much as possible. A portable belt container (see accompanying photograph) is utilized in transporting belt. Pulling the device with a Jeep or battery-powered shuttle car, the third-shift can go to either working section and extend or recover belt with a minimum of effort. A mechanic, as part of the crew, handles the electrical work so that the conveyor is ready to run for the next working shift. The same procedure, of course, holds true when there is work to be done on the mother belt.

In regard to maintenance, one mechanic on each production shift is responsible for taking care of the belt conveyor. This procedure has paid off

Remodeled Jeep (LEFT) employing battery-operated 7½-hp electric motor is used to transport men and materials in this belt operation. Used to carry crews to and from working faces, the trailer (RIGHT) may be pulled by Jeeps or battery-operated shuttle cars

in that the mine has had practically no trouble with belts in its ten-year history.

Conveyors at Green Diamond are not reversed for hauling supplies and personnel. Instead, remodeled Jeeps and battery-powered shuttle cars speed transportation of supervisors and mechanics, equipment, and materials. Powered by batteries, the Jeeps have 7½-hp motors, contactor controls, hydraulic brakes, and four-wheel drive. For moving personnel, the company employs rubber-tired trailers (see accompanying photograph) which are pulled by Jeeps. Battery-powered shuttle cars are used for delivery of bulky parts and recovery of roof bolts. When the Jeeps or shuttle cars travel the main slope leading out of the mine, a ¾-in. safety rope on a 100-hp double-drum hoist is utilized as a precautionary measure in case of brake failure.

It is interesting to see how everything possible in this mine has been made portable. Even the wooden section supply "kitchens" containing equipment parts are mounted on skids. The company, realizing that high-speed mining requires fast moving equipment, has constantly striven to improve this phase of the operation.

Pressure-Type Fan Employed

Using one intake, a Jeffrey six-ft Aerodyne pressure fan pushes 60,000 cfm of air through the mine. No booster fans are used. Old works are sealed off. Wood is used for temporary stoppings and cement blocks for permanent ones. Wooden doors are used on main haulageways. Jeeps and shuttle cars merely bump the doors to open them when passing through; doors automatically close after the vehicle passes.

The mine is relatively easy to ventilate because it makes very little gas, use of Airdox for blasting eliminates smoke and powder gases, and the old works are sealed off.

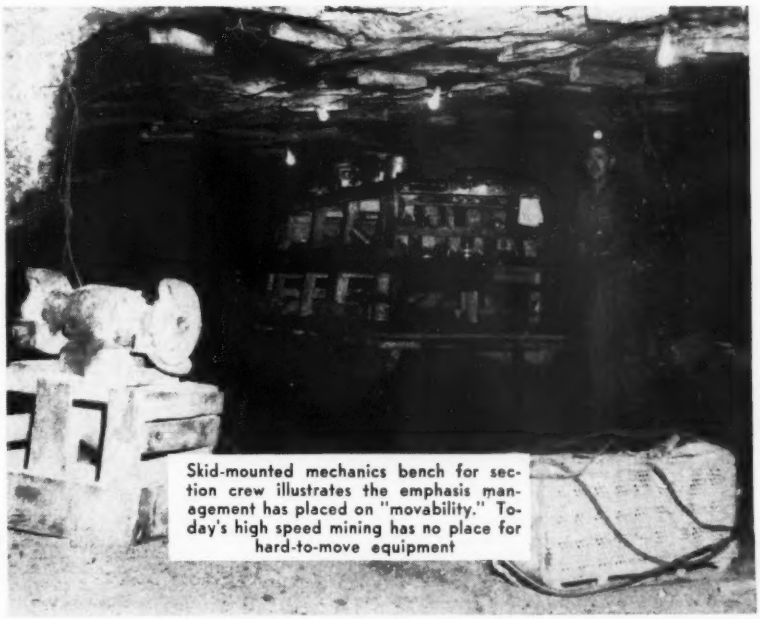
Old Works Used for Settling Pond

The subject of pumping and drainage at Green Diamond is especially interesting. The mine makes enough water for mining requirements. Water is collected at sumps and pumped via two-in. pipes to the various working faces. Small five-hp centrifugal pumps with automatic float controls are employed.

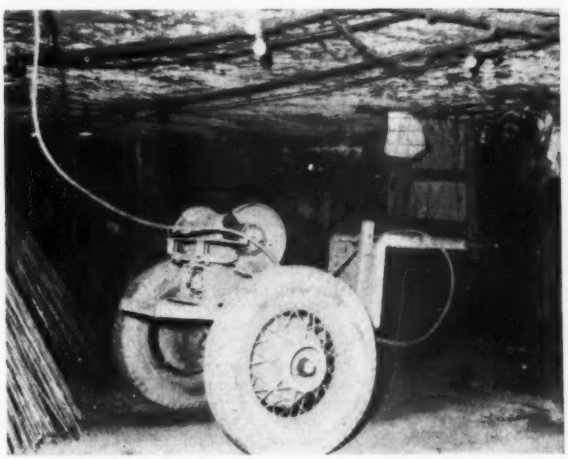
Water for the preparation plant is another story. Originally a settling pond was used to clarify water for reuse. Because this method had many drawbacks, the company eventually decided to use the mine's old works for clarifying the water. Briefly, the operation is as follows:

An eight-in. hole is drilled into a predetermined part of the old works. By means of gravity, tipple waste water is conveyed to a sump. At this point a centrifugal slurry pump, with eight-in. suction and six-in. discharge,

Electric roof bolt recovery machine. Two men recover over 600 bolts per shift



Skid-mounted mechanics bench for section crew illustrates the emphasis management has placed on "movability." Today's high speed mining has no place for hard-to-move equipment



Recovered bolts are cleaned, oiled and stacked for reuse

pumps the water through a six-in. pipeline to the drill hole, a distance of approximately one-half mile with the present setup. The water travels through the old works seeking the lowest level, depositing sludge as it goes.

From another eight-in. drill hole at an appropriate point the water is recovered with a four-in. deep well pump and pumped to a surge pond for reuse. This pump is raised from time to time as the sludge builds up underground. Management has found that there is a definite maximum limit as to the size of pump that can be used at this point. Too large a pump will cause turbulence — pulling sludge out as well as water. Only about one-third of the water that can be put into the old works can be recovered in a shift; hence, it is not necessary to pump water in as often as it is being pumped out.

When one part of the old works fills up with sludge, a new portion is chosen, necessary holes drilled, pipe laid, and a new settling pond is ready for use. This procedure has been highly successful at Green Diamond.

An interesting sidelight is the fact that the rockdust in the old works partially neutralizes the normal acid condition of the water. Thus, at least at this mine, rockdust has an added beneficial effect in addition to its safety aspects.

Face Equipment Is D-C

Green Diamond's 1500-kw transformation station is supplied with 33,000 volts a-c. The power is stepped down to 2300 volts for underground use and 440 volts a-c for the preparation plant and other surface facilities. In addition, a 300-kw M-G set on the surface supplies d-c power for the pumps and, via bore holes, for such underground equipment as the battery charger and all belt motors except the two a-c units on the bottom and slope.

The 2300 volt a-c power is transmitted through 8-in. boreholes from surface to underground to each of the two working sections. One section has an M-G set mounted on rubber tires and the other employs a portable rectifier. Moved with Jeeps, the two units are kept at the mouth of the key room and can be connected in series in an emergency. Housing facilities are made of sheet rock which is easy to install and take down. The units supply 250-volts d-c face equipment.

Preventive maintenance includes frequent inspection of the M-G set, and a small portable blower-heater is used to keep this unit clean.

Sectional breakers protect face equipment and machinery is fused. The bottom of drill holes are also fused.

Preparation Plant Can Handle 525 TPH

The preparation plant is set up to handle 525 tph of raw coal. Plant feed is generally crushed to eight in., but, depending on demand, is sometimes crushed to four in. The plant recovers to plus 25 mesh. All coal is washed and most of it is shipped to utilities. A small percentage is sold to trucks. The tipple can load on four tracks of the Illinois Central Railroad, and most of the coal is shipped by rail. Plant facilities include a five-compartment jig. A middling product is taken off, crushed and rewashed in a three-compartment jig. Equipment is all a-c. Approximately 900 gpm of water is used. Only truck coal is oiled.

During cold weather all coal is "freeze proofed" with salt. The company bases its plans on past weather history but checks local forecasts for variations. Minus 10° F is considered possible, but that is the severest weather expected. A table has been set up and the amount of salt it calls for is applied unless local forecasts predict more severe temperatures.

Underground Shop Handles Most Jobs

Most of the maintenance facilities are located underground, but a small repair shop is located on the surface for sharpening bits, repairing trucks and certain other jobs when men to do the work are available. Quonset huts have been utilized for many outside activities. A large, well-equipped underground shop handles the bulk of the mine's repair and overhaul work. Most of the supplies are also stored in this shop.

At Green Diamond, emphasis is placed on preventive maintenance. A close check is kept on equipment, which is overhauled as needed. The chief electrician determines when to replace worn units, which are then completely rebuilt for subsequent use.

Safety First Continually Stressed

A first-aid station is located on each section with enough supplies to take care of every man in the area. Self-Rescuers are included in the first-aid equipment, and all bosses carry a Self-Rescuer in addition to their safety lamp and sounding rod. First-aid courses are held nearly every year, with high attendance.

Safety first is continually stressed by management, and the employees have cooperated wholeheartedly. Proof of this was indicated in 1957 when the U.S. Bureau of Mines lauded the company for its record of producing 5,300,000 tons of coal without a fatal accident since the mine opened in 1949. This record has since been boosted to about 6,250,000 tons. During the same year the men and officials of Green Diamond were awarded a second certificate by the Bureau for completion of 100 percent retraining in the accident preventing course of the Bureau. This award was the first ever received by a coal company in the United States and is a symbol of the continuing efforts and cooperation of the men and officials at the mine to prevent mine accidents. It should be mentioned also that the employees have received four awards by the Joseph A. Holmes Association for an outstanding safety record.

In summing up, Green Diamond has consistently displayed over the years a high degree of efficiency. The company has left no stone unturned in the quest for a more efficient operation, but always the accent is on safety. New ideas and equipment are thoroughly investigated before acceptance or rejection. In short, the company is typical of the coal industry in general in its never-ending search for a better way to mine the Nation's most vital fuel.

For outstanding achievement in preventing injuries from roof falls, Green Diamond mine was awarded a National Safety Council Award in November 1958. This operation was one of 182 mines in the Nation which reached a goal of 50 percent or more reduction in the frequency of injuries from falls of roof between July 1, 1957, and June 30, 1958. Supervisory personnel at the mine include (from left to right): Arthur S. Macke, vice president and general manager; Martin O. Barber, mine manager; Evan Thomas, Jr., and Herbert Howard, underground foreman; L. Paul Martin, chief electrician; and Matt Pigford, Jr., George T. Park, Jr., and Arthur Ward, underground foremen

EXPLORATION PROCEDURE at INCO—Part I

By
THE GEOLOGICAL DEPARTMENT*
The International Nickel Company of Canada, Limited

Exploration in areas outside the Sudbury District in Canada became a major undertaking following World War II. This period coincided with the introduction of airborne geophysical methods, and International Nickel played an outstanding role in the development and use of these methods. The surge of new discoveries in Canada in the past 12 years, by Inco and others, can be correlated with the rapid evolution of modern geophysical techniques, and the willingness of large mining companies to finance these undertakings

THE prime objective of a geological department in any mining organization is to find new sources of raw materials. A secondary duty, which becomes important only after production starts, is to assist in the grade and recovery control of the ore being mined.

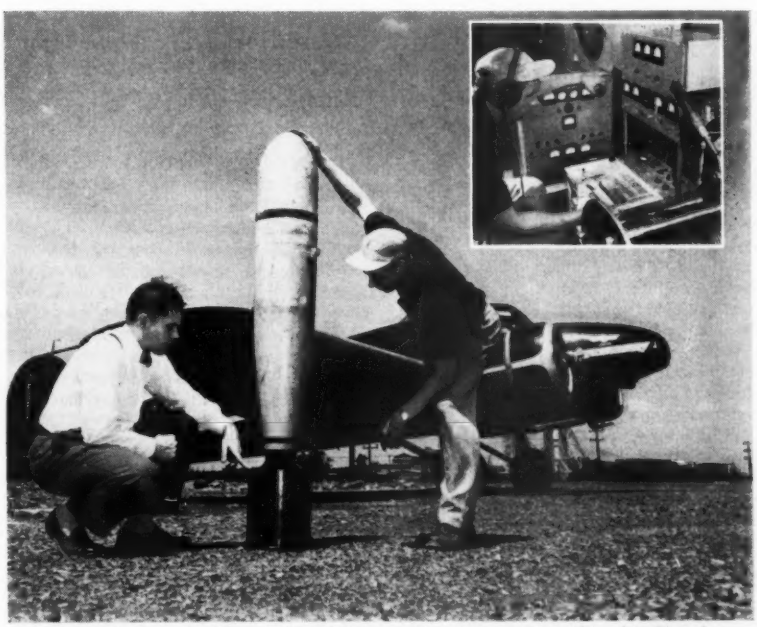
Probably the highest expression of individual geological endeavor is the geologist's role in acting as an evaluator of ore prospects and ore in the ground. The success of a mining enterprise often depends on this evaluation. The geologist must screen thousands of proposals, examine hundreds of properties and out of these select potential ore producing locations on which hard-earned dollars may be spent. However, despite all scientific aids, reasoning and research, it must be admitted that the element of chance or luck often enters the picture. Then the geologist must depart from the role of evaluator and move into the realm of possibilities and probabilities, depending on the sympathetic understanding of management in order to carry out his projects with the necessary degree of boldness and enterprise.

The Geological Department of The International Nickel Company has functioned in the search for ore and the control of mining in the Sudbury district since 1930. Prior to that time most of the geological work was done by the Mine Engineering Department. The exploration and search for new deposits outside the Sudbury district, in which the majority of our personnel are now employed, became an increasingly important branch of the Department in 1943. The period of growth in our outside activities coincides with a revival of interest in the application of geophysical methods for the discovery of hidden ore deposits. Since our present-day exploration practice makes substantial use of these methods, it is fitting that a brief review of recent developments in geophysical techniques form a part of this paper.

Nickel Ores Detected by Geophysical Methods

Nickel sulphide ores have physical properties which permit detection of the ore by geophysical methods. Nickel sulphide ores are magnetic, electrically conductive, and have a high specific gravity. These three properties form the basis for the major geophysical procedures used by the company. Although nickel sulphide deposits are much less common in their occurrence than sulphide deposits of copper, lead and zinc, they do occur in a fairly well restricted set of geological conditions. This fact, combined with the physical properties mentioned above, gave encouragement to the idea that the magnetic sulphide ores of nickel might be found by means of an airborne magnetometer.

Prior to World War II, several companies, among them the Gulf Oil Co., had been experimenting with a sensitive magnetometer for airborne ex-



Suspended beneath plane during flight, sensitive instruments within this fiberglass "bomb" detect changes in the magnetic character of the Earth's crust. The data are recorded by special equipment inside the aircraft (inset) and later analyzed by experts

*Presented at the 1958 AMC Mining Show by C. E. Michener, vice president, Canadian Nickel Co., Ltd., for R. D. Parker, vice president, International Nickel Company of Canada, Ltd.

ploration. This device was refined and improved under the supervision of the U.S. Navy and used for submarine detection during the latter part of the War. After the War, the military equipment was modified for use in ore detection. In August, 1946, successful tests were carried out over known ore occurrences in the Sudbury district by the U.S. Geological Survey in cooperation with International Nickel. In January, 1947, the contract for the first commercial airborne geophysical survey for the detection of sulphide ores by magnetic methods was awarded by Inco to Aero Service Corp. of Philadelphia and a survey was carried out over the Sudbury District.

This survey dampened our enthusiasm by revealing that the pre-Cambrian rocks contained a great deal more magnetite than had been anticipated by geologists. It immediately became apparent that a secondary method would have to be applied in order to screen out the large number of magnetic anomalies caused by numerous local concentrations of magnetite. Geological and geophysical methods were studied, the latter emphasizing the conductivity and gravity peculiarities of nickel sulphide ores. These screening techniques included the following methods which were applied on the ground in areas of magnetic disturbances found by airborne survey:

1. Visual geological examination
2. Electrical resistivity
3. Gravimetric
4. Geochemical
5. Self-polarization
6. Electromagnetic

Under special conditions, seismic methods were also tried. It was determined from this work that reasonably successful screening of magnetic airborne anomalies could be accomplished economically by ground electromagnetic methods.

For many years electromagnetic methods had been used with varying degrees of success, but they did not gain prominence in Canada until the later 1940's when more efficient equipment was developed. The successful use of E.M. methods on the ground encouraged Inco to develop corresponding airborne electromagnetic equipment. The early theoretical work and experiments with this equipment was carried out by the McPhar Engineering Co. in cooperation with our own electronics engineers. The first successful test of this equipment took place at the Whistle mine in the Sudbury District in 1950. Following this success it became clear that the airborne electromagnetic equipment would be a valuable asset in the evaluation of geologically favorable terrain. We then had two airborne methods of measuring the special physical properties mentioned earlier in this paper. It was found that in most pre-Cambrian districts, a combination of the two methods along with geological studies made a comprehensive evaluation possible. This permitted the elimination of large areas from further investigation by our Company. In the years following, airborne magnetic and electromagnetic surveys have continued to be used and the techniques and equipment improved. A staff of seven men is maintained on geophysical research, development, and maintenance, with the result that highly effective work can now be carried out on an operational basis.

Anomalies detected by airborne methods can be easily located on the ground and a more extensive investigation made with portable geophysical equipment

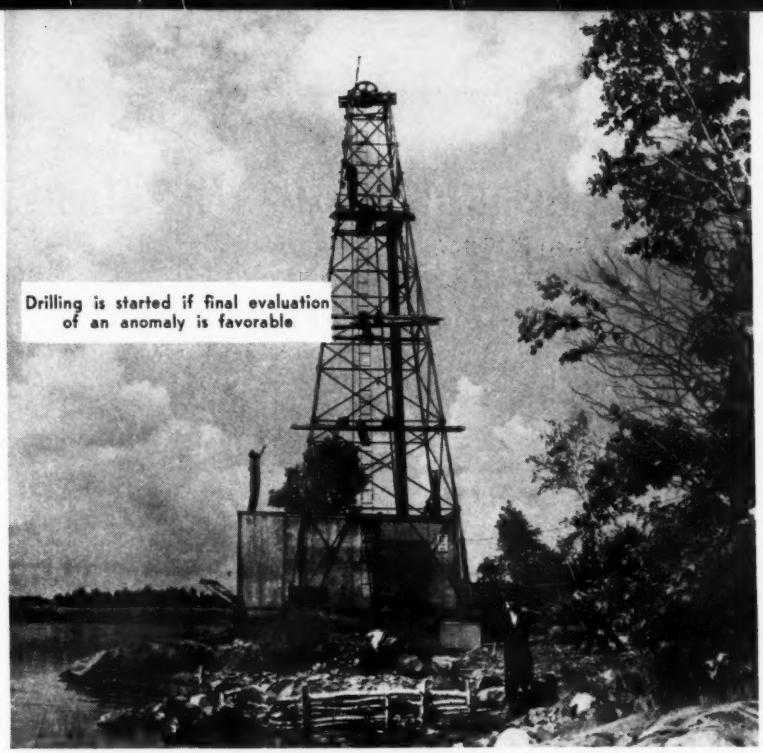
Selection of Areas for Field Studies Most Important

In outside exploration, over 90 percent of our geological effort and expenditure goes into areas selected by the Geological Department for intensive work. The balance of the expenditure is generally allocated to properties which have been discovered by other individuals or companies and brought under control by option or purchase. The selection of an area for detailed examinations is of the utmost importance, since once the decision is made a great deal of time, effort and money is usually involved before the district can be established either as productive or of no further interest to the company. Since our search is primarily for nickel-copper deposits, which have unique characteristics and generally occur in a particular geological setting, this problem of area selection is narrowed down to a considerable degree. The current practice has been to use a set of flexible criteria, to each of which a priority rating is assigned. In the consideration of a geologically favorable area, if the total score from these priority factors adds up to a better than average figure, serious thought is given to selecting this area for detailed examination.

Priority Factors

1. Rock mineralogy, with special reference to MgO content and volatile content
2. Rock texture
3. Evidence of nickel-bearing sulphide
   (a) Nickel mainly as sulphide
   (b) Nickel mainly as silicate
   (c) Nickel part silicate and part sulphide
4. S/Ni ratio
5. Degree of differentiation
   (a) Layering not recognizable to moderate
   (b) Extreme layering
6. Shape and attitude
   (a) Lopolith, basin, thick sill
   (b) Plug
   (c) Dike, thin sill
7. Volume (quantity of source rock)
   (a) large
   (b) medium
   (c) small
8. Presence of major structure or lineament
   (a) Major structure contains ultrabasic rocks
   (b) Structure represents deep-seated fault or shear zone
9. Economics—with special reference to location and transportation

Commercially productive nickel sulphide deposits are of two main types. The first, which has been called by Inco's staff the Sudbury type, consists of orebodies in which copper and nickel occur in roughly equal amounts and the ore is closely related to, and occurs with, intermediate rocks of the norite type. These rocks generally show some degree of magmatic differentiation, and evidence of the presence of abundant volatile constit-



Drilling is started if final evaluation of an anomaly is favorable

uents. The second type generally contains very little copper in proportion to the amount of nickel, and the ore is associated with or occurs in, ultrabasic rocks of the peridotite type. Nickel silicate or oxide ores which occur only as surface concentrations over ultrabasic rocks in tropically weathered countries, are not considered here. The final decision by the Department as to whether or not a major expenditure should be made on a prospective nickel area is based on the following factors—with a certain weight being assigned to each priority factor, dependent on the local conditions.

When it has been decided to undertake a full-scale investigation of a particular area, preparations for an airborne geophysical survey are made. A lay down mosaic is completed of the district, using aerial photographs, and the flight lines are laid out at one-quarter mile spacing across the geological grain. The area is then flown with both magnetic and electromagnetic equipment. If possibilities for uranium exist in the area, a scintillometer is usually carried in the plane. The magnetic results from the survey are reduced graphically and represented by means of contours. The electromagnetic indications are similarly reduced and shown by means of symbols which indicate the priority and other characteristics of each response. The magnetic and electomagnetic anomalies are studied together and the resulting evaluation determines the priority and the sequence of their examination on the ground. The airborne results are also used by the geologist for purposes of geological interpretation. This work is very exacting and is entrusted only to the senior geologists and geophysicists.

The field parties charged with the ground examination of the selected anomalies generally consist of both geological and geophysical personnel. If the rocks are exposed over the anomaly position, it may be possible for the geologist to determine the cause of the magnetic and electromagnetic disturbance from visual examination. This, of course, results in an early decision as to whether further work is required. If however, the anomaly as located on the ground is covered by overburden, standard geophysical procedure is applied.

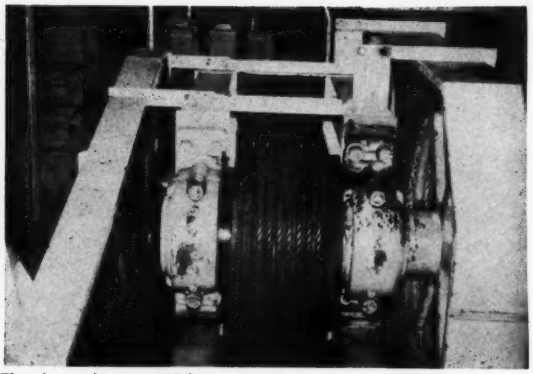
Procedure for Checking Anomalies Described

A brief description of the methods used to locate the anomaly on the ground and the procedure used to follow it up may be of interest here.

All positioning is done by topography without reference to actual latitude and longitude. The airborne geophysical anomaly is plotted on an air photograph which is used by the ground party to guide them to the location. If the flight control during the survey has been effectively carried out, the location of the anomaly on the ground is generally found within 200 feet of the indicated position. Having placed the electromagnetic transmitter at the selected location, a series of four lines is run by the receiver around the transmitter in the form of a square and at a distance of 400 or 800 feet. Further electromagnetic work establishes the strike of the conductor. Profiles are then run at right angles to this conductor with a magnetometer. This preliminary information is used to check the general nature of the anomaly. At this stage, the local geology is also plotted. If the combined geological and geophysical conditions are favorable, a detailed ground survey is carried out using both geological and geophysical methods. In certain areas where transportation costs are high, the anomaly may be checked as to depth of overburden by use of seismic equipment; and in special cases, a gravity survey is conducted using the Worden type gravity meter. The anomaly is now ready for final evaluation. The decision to drill is made by the Chief Geologist in consultation with the geological and geophysical staff who are familiar with the local details.

The development of Canada's natural resources progressed very rapidly following World War II, and the discovery of large iron ore deposits of Quebec and Labrador spurred interest in development of the Arctic barren lands of Northern Canada. A large percentage of these areas on the mainland of Northern Canada had never been prospected or even seen by exploration geologists. A great many gossan outcrops occur in the barren lands, and prospecting from the air was introduced by Inco in 1949 as a means of investigating these relatively unexplored areas. The method worked out for locating and sampling the gossans is relatively simple and inexpensive and involves the use of a small float equipped aircraft, and an exploration party of five men. Detailed topographic maps or aerial photographs are used to control the flight lines which are flown at a spacing of two miles. Regular flights are carried out on this pattern and the major geological features and the gossan outcrops are noted. Two observers and one pilot flying at an elevation of 1500 feet make up the flight crew. The other members of the party are moved progressively from one gossan area to another for the purpose of geological reconnaissance and sampling. In certain types of terrain a helicopter is used to move the sampling parties. Since 1949, large areas of the barren lands of Northern Canada's mainland have been covered by this rapid reconnaissance method. Several hundred gossans have been sampled and a few of these have contained sufficiently interesting values in copper and nickel to warrant diamond drilling.

Next month *Mining Congress Journal* will present the second part of "Exploration Procedure at Inco," which will cover such topics as Current Practices in Mine Geology, Sampling, Research, Costs and Conclusions.



The hoist has a 125-hp a-c motor which transmits power to tandem rope drums through a gear drive. Note that the cable is wrapped eight times around the drums of the hoist*

Reducing Coal Preparation Costs Through AUTOMATION

By GEORGE H. MORRIS

Preparation Engineer
Indiana Division
Peabody Coal Co.

In coal preparation plants, as in any processing plant, there is great potential for the use of automation to cut operating costs. Here is how Peabody Coal Co. mechanized clean coal loading and railroad car handling to the fullest extent possible at three of its large operations to achieve reduced costs, improved safety and higher quality coal.

THE Victoria, River King and River Queen mines of Peabody Coal Co. are loading from 6000 to 9000 tons of coal per 7 hour and 15 minute shift with one man each, who controls all loading chutes and car movements for loading.

Victoria Mine

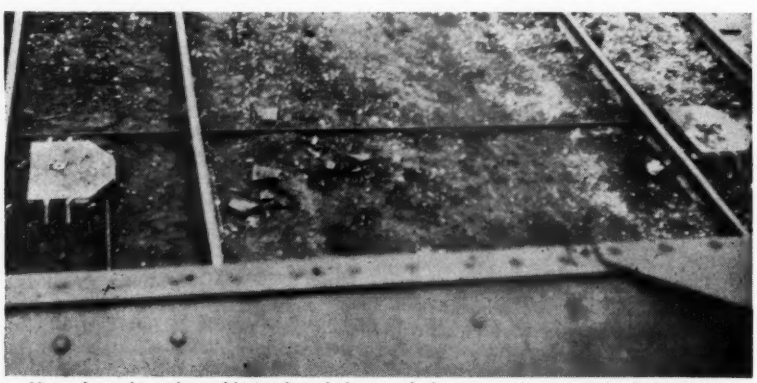
In planning for the Victoria mine the management planned to mechanize to make the operation as automatic as possible at the loading point. It was decided to use a car haul to accomplish this.

Car haul equipment. The car haul consists of a hoist, one 125-hp ac motor which transmits power to tandem rope drums through a gear drive; one speed variator controller, which permits the speed at which the cars are moved to be varied, and two coupler cars which are attached to pull ends of 2070 ft of 1¼-in. wire cable. In reality, two cables are used. To the front part of the coupler on No. 1 track is fastened one end of a 1115 ft wire cable; the cable is wrapped eight times around the drums of the hoist.

There are counterweights used on this cable just before it is wrapped around the drums, and just after it leaves the drums. These counterweights act on the slack line. Weights bear against stops when the line becomes a pulling line.

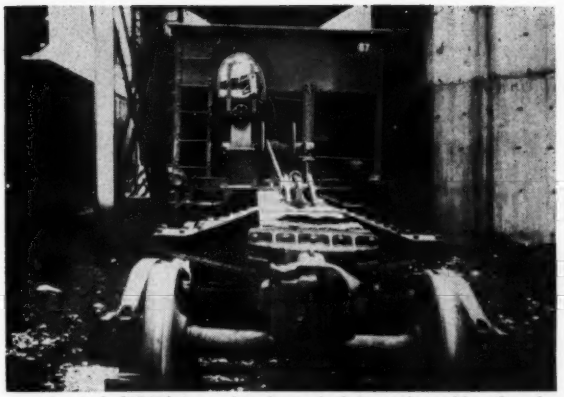
The other end of this cable is fastened at the front of No. 2 coupler to a winch, which is used to keep slack out of the cable. The second cable, which is 955 ft long, is fastened, one end to the back of No. 1 coupler, and the other end to the back of No. 2 coupler. The couplers are so connected that the 13 cars being loaded travel in one direction and 13 empties travel in the opposite direction, getting into position for loading.

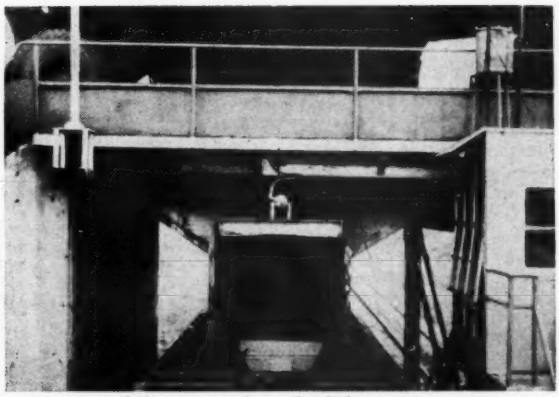
Tracks. There are two tracks under the loading point. Total length of load and empty track is 2700 ft. There is no additional track for storage. The two tracks are served by one loading point, and when coal is being loaded on one track, empties are being reversed into loading position on the other. There is a small surge hopper above each track, and runways are so arranged that a truck from either direction can pull over



View shows how the cable is threaded around sheaves as it enters the hoist building from No. 1 track and returns on No. 2

* *All illustrations in this article were taken at Victoria mine.*





A winch (LEFT) is used to keep slack from the cable. Couplers are so connected that 13 cars being loaded travel in one direction and 13 empties travel in the opposite direction to get in position for loading. Closing the gate (RIGHT) to stop the flow of coal from the surge hopper, the operator moves the next empty under the loading chute. A truck is dumping its load into the hopper, which holds approximately five tons

either hopper, dump its load, pull just off the hopper, turn and come back across the other hopper on its return trip. The surge hoppers hold approximately five tons.

Loading control tower. The loading control tower is located between the tracks. One man in the tower handles all loading operations. He has a total of five controls to operate. There is a control for each track to operate a gate which stops the flow of coal from the surge hoppers. The operator also has a control for each track which operates a movable lip on the end of the chutes, permitting him to trim the railroad cars and affording more uniform loading—thus insuring a full car of coal with reduced spillage in transit. Both the gates and movable lips are operated by air cylinders. The fifth control is the one which controls the speed with which the cars are moved. Under the old way (by which the company has operated other mines), it would require four men to do what one does at Victoria.

Railroad service and equipment. A jointly owned railroad serves the mine, making a round trip each 60 minutes on the average. The distance from mine loading site to river dock facilities is six miles. The approximate time required for the round trip, from mine to dock and back to mine, is 50 minutes. The engine is in the Victoria yards approximately ten minutes. During this ten minute period, the 13 empty cars which have been brought back from the dock are coupled to the empty, receding coupler. The engine then switches to the opposite track and couples onto the 13 cars which are being loaded. As soon as the last car in this string is loaded, the operator signals the engineer and he leaves with another trip of 13 loads for the dock. After the engine couples on to the string of cars being loaded, the hoist pushes the engine as well as the cars. The railroad has 39 70-ton cars which are used in the shuttle between the mine and dock facilities at Yankeetown, Ind. Thirteen of these are at the mine being loaded; 13 at the dock being unloaded, and 13 in transit.

Weighing of coal. All coal from the mine is weighed by automatic belt scales at Yankeetown Dock.

River King Mine

At the time River King mine was in the planning stage, Peabody had been operating Victoria for some time. The car haul had performed in such a way as to give management the courage to try and work it in at River King, even though this was to be a preparation plant, producing several sizes of coal. There was also the added problem of loading coal for common carrier railroad shipment as well as for barge shipment. The following was worked out to meet these problems.

Car haul equipment. This included two hoists, each of which consists of two grooved cast iron drums, and a speed reducer, 21.4:1 ratio. Hoist shafts are mounted in roller bearing pillow blocks. Reducer high speed shaft is Steelflex coupled to 8:1 variable speed range d-c motor, which is part of a 100-hp ac-dc package. Each car haul is equipped with a 100-hp d-c motor, and all have d-c brakes. Each unit is connected through a speed variator; two five-point magnetic controls enable the speed at which the cars are moved to be varied from 3 to 24 fpm. Four coupler cars are attached to pull ends of 6360 ft of 1¾ in. wire cable in the same manner as at Victoria. To each of these coupler cars are coupled 39 70-ton cars, or 43 50-ton cars. With the greater number of cars attached to the coupler car, it was necessary that ballast be added to keep the coupler cars from jack-knifing. This was done by fastening a steel box on the coupler car and filling it with 25 tons of concrete. Coupler cars are also equipped with luminous reflectors so that train crews can spot them at night.

Tracks. There are four tracks under the preparation plant. Total length of load and empty track is 13,200 ft with an additional 3900 ft of sidetrack. The four tracks provide two loading points, with coal being loaded on two tracks and empties being reversed into loading position on the other two. As at Victoria, gravity is not used.

Loading control tower. This tower is located between tracks No. 2 and No. 3. One man in the control tower controls all loading and selection of sizes. Loading is controlled and car changes are made by the operator through the use of motorized rack and pinion forward and reverse pant leg chutes. Size selection is also made by the operator through the use of motorized rack and pinion slide-doors in a mixing conveyor. Under similar conditions, without the car haul, it has been necessary to have five or six men to do the work now handled by one man.

Sizes loaded. The total preparation plant product can be loaded on any of the four tracks, or two separate sizes can be loaded simultaneously. It is possible to load several sizes, but the two sizes which are loaded simultaneously must be the total preparation plant product. As an example, 5 by 1 in. can be loaded on either No. 1 or No. 2 tracks, while 1 in. by 28 mesh is being loaded on either No. 3 or No. 4 track, the combination of these two sizes being the total preparation plant product. The 5 by 1 in. product is at times crushed to make different top sizes. At the present time, the opening and closing of the crusher is done manually. However, it is expected that before long the control operator will be able to do this automatically by pushing a button.

Railroad Service and Equipment. A company-owned railroad serves the mine four times a day: at 2:00 a.m., 1:00 p.m., 5:00 p.m. and 10:00 p.m. This railroad, the only one serving the mine, is approximately 23 miles long. One hundred forty-eight

cars are used in the shuttle between the mine and Peabody's dock in East St. Louis, Ill. The cars are 50 and 70-ton units. In addition, the railroad handles mine cars from five different common carriers. These are 50 and 70-ton cars and they come and go at random. They are cleaned by the company-owned railroad. Common carrier coal is turned over to the TRRA and A&S at East St. Louis or, as in one case, directly to the common carrier. The clerk at the mine notifies the railroad serving the mine on which track to place the shuttle cars for dock shipments and the common carrier cars for rail shipments.

Weighing of Coal. Coal to be loaded in barges at Peabody Dock, East St. Louis, is weighed by automatic belt scales at the dock. Coal to be delivered by rail is weighed by the company-owned railroad at Belleville, Ill.

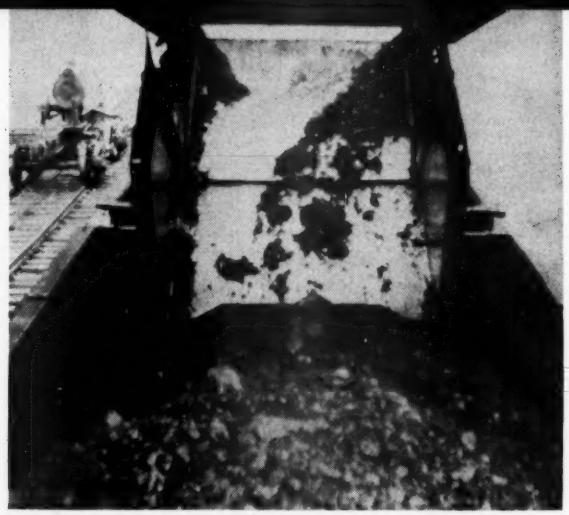
River Queen Mine

When the preparation plant was designed for the River Queen mine the car haul was included in spite of a more difficult loading and handling problem than at either Victoria or River King. The preparation plant at River Queen produces several sizes of cleaned coal and the following was worked out to meet the special problems posed by the need to handle several combinations of sized coal.

Car haul equipment. Two car hauls are used and they are identical to the ones used at River King. Four coupler cars are attached to pull ends of 8274 ft of 1-¾ in. wire cable in the same manner as at Victoria and River King. Ballast was added to the coupler cars on all four tracks in the same manner as at River King. To each of the coupler cars on tracks No. 1 and No. 2 are coupled 42 50-ton cars or 30 70-ton cars. To each of the coupler cars on tracks No. 3 and No. 4 are coupled 30 100-ton cars.

Tracks. There are four tracks under the preparation plant. Total length of load and empty track is 16,967 ft, with an additional 2789 ft of sidetrack. The four tracks provide two loading points. Coal which is to be delivered by common carrier railroad is loaded on tracks No. 3 and No. 4. At River Queen, gravity is used so that cars loaded for delivery by common carrier can be cut off and ridden over scales and weighed. No gravity is used until just after the cars have passed the sheaves on the north end of the track. At this point, a slight down grade starts.

Loading control tower. The loading control tower is located between tracks No. 2 and No. 3. One man in the tower controls all loading. The loading is controlled and car changes made by the operator through use of motorized racks and pinion. As at River King, one man operates the car haul and does what it used to take five or six men to do.



Peabody has found car hauls improved safety. Reason: three to five men have been eliminated from coupling and climbing up and down cars continually on each shift. This situation was especially dangerous during inclement weather

Sizes loaded. The total preparation plant product can be loaded on tracks No. 3 and No. 4, or any part of the total preparation plant product, which is not being loaded on tracks No. 1 or No. 2.

Railroad service and equipment. Both a company-owned railroad and a common carrier railroad serve the mine. The company-owned railroad has, at this time, 30 100-ton cars which are used in the shuttle between the mine and dock. Fifteen of these cars are at the mine being loaded, while the other 15 are being delivered to the dock, unloaded, and returned to the mine. Unloading time at the dock is approximately 40 minutes and loading time at the preparation plant is from an hour to an hour and 50 minutes, depending on what percentage of the total preparation plant product is being loaded for barge shipment. The distance from mine to dock is 6.8 miles, and the time required for the round trip, including unloading of the 15 cars at the dock, is approximately an hour and 30 minutes. The common carrier delivers its empties to the mine and leaves them on a side track. The mine checks and cleans the cars which require it, then couples them to whichever coupler is empty, on track No. 3 or No. 4.

Weighing of coal. Coal loaded into barges at the dock is weighed by automatic belt scales at the dock. Coal which is delivered by common carrier railroads is weighed at the mine on railroad scales and dropped by gravity to a load yard where the common carrier railroad receives it.

Preparation Costs Reduced with Better Operating Time

The labor which was eliminated by the car haul at each mine has been mines which is approximately the size mentioned. There has also been a substantial preparation cost reduction. Over a period of time, at one of the of the River Queen and with about the same operating conditions, an average 100 man hours were lost each month from ground stops. These stops, for the most part, were caused by (1) cars not rolling when the retarder was released (the retarder man, for one reason or another, failed to pinch the car and start it moving in time to prevent a shutdown of the plant); or (2) the man riding empties down comes in too fast and tears up a retarder, knocking the cars from under the loading point, thus causing an emergency stop and spilling several tons of coal on the ground. Coal must be cleaned up and, in most cases, the retarder must be repaired before loading can start again. When gravity is used and men ride empties under a loading point, any number of things can and do happen which cause lost time. Some of these will be the man's fault, some the fault of the weather, and some due to the failure of equipment. Add to these the number of times a loaded car gets away, derails, or tears up track and blocks loading, and you soon account for 100 man hours each month. With the car hauls, almost all these losses have been eliminated.

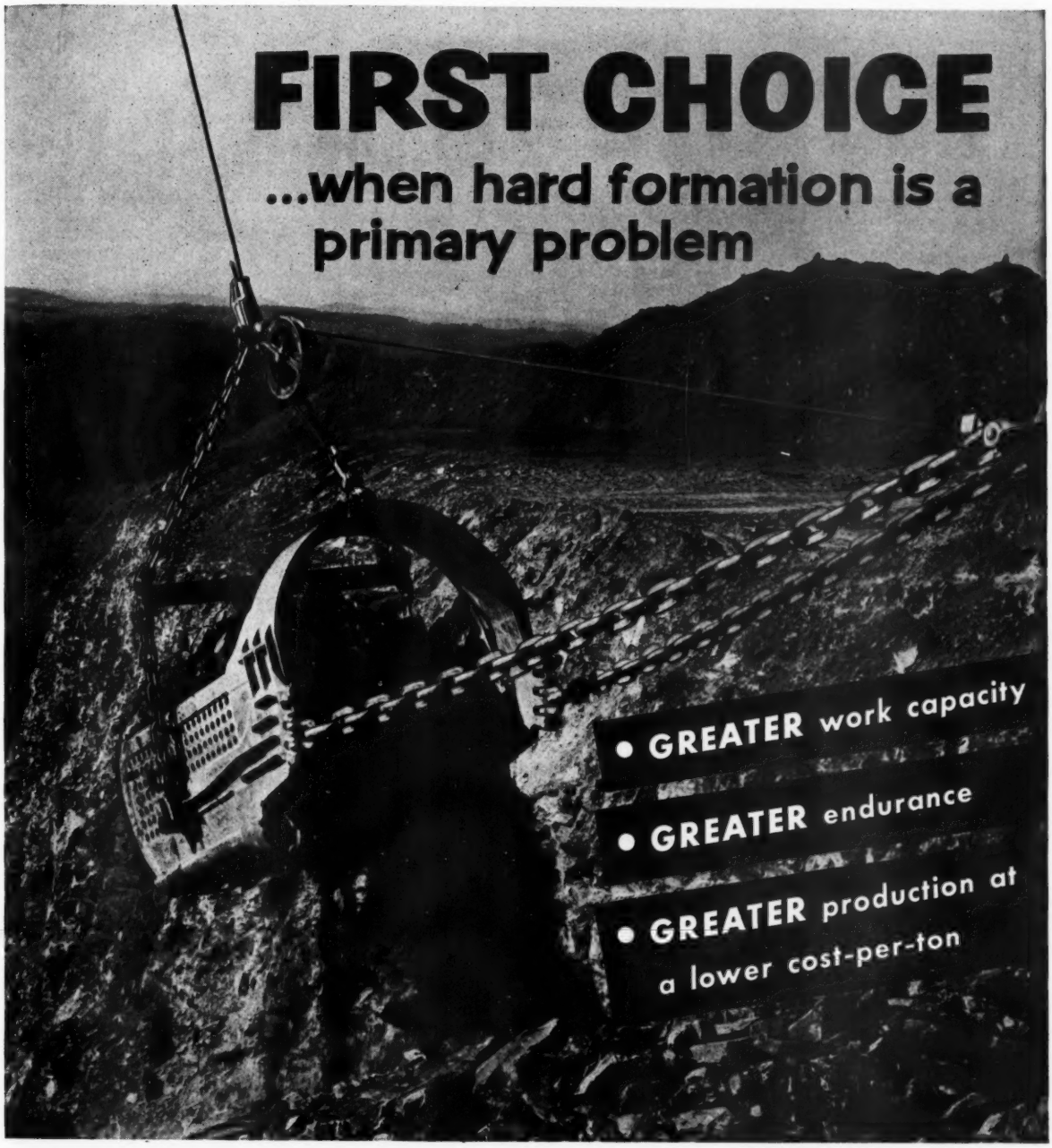
Car Haul Improves Quality of Coal

The quality of coal from the preparation plants has also been improved by the elimination of ground stops which shut down the plant. Each time a plant is shutdown, the efficiency of cleaning and heat drying is decreased. Also affected is the blending of sizes where no blending bins are used.

Unsafe Jobs Eliminated

Safety has been improved at the plants using car hauls because three to five men have been eliminated each shift from coupling and climbing up and down cars. This situation is especially dangerous during cold, rainy or freezing weather.

The company feels that through automation it not only has reduced the cost of coal preparation by the elimination of labor and plant down time, but has improved the uniformity and quality of the coal and made the preparation plants a safer place. All these items must be considered when you think of reduced coal preparation costs through automation.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The ground is drained before stoping operations start. Haulage drifts are extended below the ore as rapidly as possible, with vertical upholes drilled during the advance to speed drainage

Ambrosia Lake

Mining at Homestake-New Mexico Partners

By RICHARD J. STOEHR
Superintendent of Mines
Homestake-New Mexico Partners

At the present time, Homestake Mining Co., as general partner of two limited partnerships, is developing four uranium mines in the Ambrosia Lake area. In three of these mines, the ore is 150 to 300 ft below the static water level and 600 to 800 ft below the surface. In the fourth mine, a substantial amount of the ore is above the water table. The following remarks are confined to the three wet mines.

Pre-Operational Tests Conducted

In late 1956, when Homestake began taking an active interest in the present operating properties, approximately 450,000 ft of exploration and development drilling had been done from the surface, and substantial orebodies had been blocked out. Little was known about the mineability of the ore and nothing was known about the water—other than that water was found in a few wells in the district and a water problem was suspected.

Homestake immediately set out to evaluate the physical and hydraulic properties of the ore-bearing sandstone. Utah Construction Co. was engaged to work in conjunction with the Homestake staff on a series of well-designed water tests. Without going into detail, these basically consisted of a series of tests using five water wells and 15 observation holes. Each water well was pumped independently and the observation holes were constantly checked for draw-down and recovery. These tests were conducted over an area of approximately three sq mi.

From the data accumulated during these tests it was definitely determined that the ore occurred in the water-bearing sandstone that had properties of a fair aquifer. The tests also supplied data for determining the coefficient of permeability, the coefficient of transmissibility and the storage coefficient. Estimates of the total water inflow and sustained flow in the planned shafts and drifts were made using these coefficients. It was necessary to assume that the sandstone was homogeneous and the permeability was the same in all directions. This later proved to be false.

During the water testing, Homestake also conducted a series of strength of materials tests on core extracted from the ore and waste rock immediately above the ore. These tests indicated that the sandstone lost 30 to 40 percent of its strength due to water saturation, and that the strength of the rock increased proportionately as it lost its moisture content. The lowest compressive strength of saturated core that was recorded was about 1081 psi. (See table.)

The water tests indicated that even though the quantity of water anticipated was quite large, it could be handled within the limits of the economics of the orebody. The strength of materials tests indicated fair ground conditions.

(Continued on page 49)

Mining below the water table presents some tough problems. However, the picture is getting brighter as more experience is gained, and operators are optimistic about the tremendous potential of the Ambrosia Lake District

The sand at Ambrosia Lake is highly abrasive to every mechanism. Jack-leg drills require extra maintenance, and therefore it is necessary to have two or three times the usual number of machines available

Mining at the Ann Lee Mine

By RAY JENKINS
Superintendent of Mines
Phillips Petroleum Co.

THE Phillips Petroleum Co. has one mine in production and two other mines in which shafts are being sunk in the deep portion of the Ambrosia Lake mining area. These three mines will furnish ore to the company's 1725-tpd mill which was completed in June of 1958. The Ann Lee mine was bottomed in January 1958 and station pockets and bottom equipment were completed in May. Experience to date indicates that the company will better the original estimates on productivity costs and ore reserves of this project.

Geology

The three mines are in the Westwater Canyon member of the Morrison Formation. They are beneath the permanent water table and are classified as wet mines. The Ann Lee mine is the only mine on the ore level and at this time has about 12,000 linear ft of workings opened.

The mining conditions in the Ann Lee mine are largely controlled by the nature of the rock in which the ore bodies occur. The ore bodies now being mined are closely associated with a coarse, conglomeratic sandstone which lies between fine-grained, silty sandstones. The ore, the floor, roof, and water conditions are different for each of these units, and the local mining problem depends entirely in which unit the workings are located.

The lower ore body conforms in general with the contact between the silty sandstone and the base of the coarse, conglomeratic sandstone. It consists of pods and stringers of ore oriented along a very definite strike line, and varies in thickness from one to four ft. The mineralization penetrates both upper and lower formations in a random fashion. The width of the ore zone is approximately 80 to 100 ft. In this ore body, the soft, silty floor tends to abrade and rut badly with certain types of loading equipment. The roof conditions are good, and only roof bolts are used. The walls tend to slough into an hourglass shape and then become stabilized. This is not a serious condition

(Continued on next page)

unless the room heights are over seven ft. A few fissures are encountered in the coarse beds and these are water bearing, but usually drain out. The coarse formation is porous and makes some water as the face advances.

The other ore body lies within the coarse sandstone. It is much more persistent and thicker. It rises from near the base of the coarse sandstone and transgresses the bedding to the overlying silty sandstone, and, locally, to the Brushy Basin member. The ore is quite strong, and drifts driven within the ore body stand very well with roof bolts. The coarse sandstone makes a good mine floor and allows the use of heavier loaders. The ore penetrates into the overlying silty sandstone, which is generally thin-bedded and soft. Experience to date indicates that this sandstone can be bolted and will stand well with room widths up to 10 ft. This formation must be bolted immediately; rooms wider than 10 ft will break up between the bolts and slough. The coarse ore zone does not seem to have any water except in fractures, and these drain within one or two weeks after they are encountered.

Where soft floor conditions are encountered, crawler-mounted, electric, continuous loaders and six-ton diesel shuttle trucks are used. Maintaining good road beds is practically impossible

Mine Development

The Ann Lee mine is opened by a five-compartment shaft with two skips in balance and a man and material cage. The shaft is located approximately in the middle of the ore bodies. The mining level is set at 660 ft, or approximately the elevation of the ore bodies in that area. The ore bodies rake from west to east. On the extreme west end, they are 70 ft above this level, and on the east end 40 ft below. Approximately 75 per cent of the reserves lie above the mining level. Multiple level development was impractical due to the long barren drifts necessary for opening more than one station and the weak rock adjacent to the shaft. To date all grades encountered are within the range of trackless equipment.

Two 36-in. inside diam vent shafts are located 600 ft north and one 200 ft south of the hoisting shaft. One vent shaft is equipped with a ladderway as a second escapeway. The vent shafts and main shaft are connected at the mining level with a crosscut which cuts all the ore horizons. These ore horizons are developed by double entry system where they are wide enough. The narrow ore bodies are developed with a single entry with crosscuts right and left. The thick ore bodies are developed with a fringe drift on the low side and a parrallel lateral with crosscuts connecting the fringe drift. Parallel rooms are turned off the fringe drift at 20-ft centers. The rooms are driven 10 ft wide to the limit of the ore. The 10-ft pillar between the rooms will be extracted by open-ending or windows and stumps, depending on roof conditions. In some places where the ore is very rich, the use of solid cribs with sand fill from surface may have to be used to get complete extraction. It appears at this time that an elaborate pillar drawing program to develop a cave line will not be feasible because of the variations in ore thickness and floor contour.

Drilling and Blasting

Jack-leg drills are used throughout the mine. The company has tried pneumatic and hydraulic-powered jumbos, but have not been able to justify them due to the high cost, lack of mobility, and the irregular heights in the Ann Lee mine. The output per man-shift of good jack-leg operators compares very favorably with the jumbos that have been tried. The maintenance on the jack-legs is very high, principally due to sand getting into the machines. To overcome this, it is necessary to have two or three times the usual number of machines available. For this same reason, the company prefers the retractable to the telescopic-type leg.

Single-use, 1½-in. carbide cross bits on ⅞ by 4¼-in. hex steel are used. Bit life is about 750 ft.

Present practice is to use semi-gelatin ammonium nitrate dynamite in one by 16-in. sticks with a heavy waxed wrapper. The velocity is 12,000 ft per sec and there are 90 sticks per box. Lower velocity dynamites were tried, but found to be lacking in strength due to the added weight of the water in the rock pores. These dynamites were successfully used in the dry mines with similar ores. It was also difficult to get sufficient water resistance in the lower velocity dynamites. One by eight-in. 30 per cent gelatin primer sticks are made up in the magazine with standard delay electric blasting caps. Approximately 31 seven ft holes are used in a burn cut round with about 10 percent bootlegs remaining. Powder consumption is about 1.5 lb per ton.

Loading and Hauling Equipment

At the present time, where floor conditions permit, Phillips Petroleum is using diesel-powered, front-end loaders and six-ton diesel shuttle trucks. These units are equipped with scrubbers and have Bureau of Mines' approval plates. Where soft floor conditions are encountered, or where a five to six-ft room height is desired, Joy 8-BU crawler-mounted, electric, continuous loaders and the same shuttle trucks are used.

In the early stages of development of this mine, the shaft contractor used slushers and crawler-mounted, overshot loaders. Both of these units were used in the areas with a silty sandstone floor and under extremely wet conditions. It was found that it was almost impossible to follow a level, and the floor was very badly cut-up and converted into a slurry which resembled "Cream of Wheat". This slurry was too thick to be pumped and almost too thin to load. By driving the entries at about 5 percent upgrade, it was possible to get the initial development work completed. The Joy loaders were then put into operation. Where slurry conditions were encountered, these loaders actually tended to dewater. Because of the highly abrasive, wet slurry, it was necessary to make numerous modifications to the gear cases, undercarriage, and conveyor booms. The transmissions and differentials will not stand the added load of grades in excess of five percent. The gathering head is also too light to dig properly in downgrade entries if the sand tends to pack. Where there are steep grades and good floor conditions and seven-ft minimum heights are practical, diesel-powered, front-end loaders are used. It has lower maintenance and much greater mobility

than the electric loader, but it has a slower loading rate and is harder on the haulage equipment. In some places. the added ventilation requirement is a handicap.

For haulage, Phillips uses six-ton diesel trucks with torque converters and power steering. These trucks have proved to be very flexible and rugged. The maintenance of the road beds is practically impossible due to the running water and sand, and the ruts and chuck holes that develop are extremely hard on these trucks. At the present time. it does not seem feasible to consider any other type of haulage. As the mine is extended, however, larger diesel-powered trucks will probably be considered.

Roof Bolting

The roof bolting program was developed with the assistance of the State mine inspector. Four and six-ft bolts, with nine-in. left-hand threads and 1⅝-in. heavy model expansion shells, are used with triangular plates and landing mat sections. The sections vary from 12-in. squares to 12 by 60-in. depending on conditions. Wire mesh is used on some of the walls and backs where local spalling conditions exist.

The bolts are usually on 4-ft centers with a maximum of 5 ft and are staggered where possible. Telescopic leg stopers with 1⅝-in., single-use carbide cross bits are used to set the bolts, which are tightened with an impact wrench two days later. A two-man crew can usually set 50 bolts in an eight-hr shift.

The successful application of the roof bolting program has resulted in a considerable saving in labor and material handling. The elimination of timber in the headings has meant greater safety and more efficient operation of the loading and haulage equipment.

Pumping

Pumping problems are divided into two areas, the pumping at or near the face, and the mine pump stations. Near the face, six-hp electric submersible pumps have been found to be the most satisfactory. These pumps are suspended from the roof bolts and pump behind dams through Marlex polyethylene pipe lines. Where the headings are driven up-grade, the water is allowed to spread over the entire floor. The coarse sand is dropped near the face where loaders can pick it up. The water is then conducted to the pump stations where a dam and clear well are located. The water is pumped into the dam with six-hp pumps. The dam spills into a clear well with positive suction feed to 800-gpm, 800-ft head, 250-hp pumps which raise it to the surface. The water is stored in a large surface reservoir to settle clay and fine sand prior to going to the mill. A 440-volt system using two-stage pumping and 50-hp pumps is also available for standby. It is not practical to settle clay and fine sand underground or to install the conventional type of sump. The sumps used at Ann Lee are dams placed in entries or dead-end drifts. The dams are removable to allow loaders to enter. The clear wells are equipped with agitators.

Water comes from two strata: the Dakota, which is pumped in a separate line to the surface, and the Westwater in which the mining is conducted. The Dakota makes about 90 gpm and has decreased only slightly since it was encountered. The westwater increased from 200 gpm when first encountered to a peak of 600 gpm. At the present time it is about 400 gpm. This decrease has taken place even though the rate of development is constantly increasing.

Ventilation

The main mine ventilation system consists of three upcast 125-hp, 35,000 cfm Joy, two-stage fans located on the surface at the three 36-in. vent shafts noted above. The underground distribution is through intake and return air ways with the stoping in the breakthroughs. The system carries 20,000 cfm at the last breakthrough, and face fans are used ahead of the breakthrough. In single-entry drifts, 25-hp fans are used with 20-in. metal vent pipe carried to within the required distance of the face. Small three and five-hp blowers in vent tubing are used for ventilating crosscuts and rooms off the main drift. To insure ventilation of the longer rooms, windows are cut through the pillars.

Electric Power Distribution

Two 4160-volt mine feeders enter a central substation in the shaft bottom. This power is then distributed at 4160-volts to conventional mine-type 150 and 300-kw power centers where it is reduced to 440 volts. Additional distribution beyond the power centers is accomplished by use of safety circuit centers. A great deal of care has been taken to make all of the distribution system as safe as possible because of the wet conditions under which equipment must be used. Both ground circuit and pilot circuit protection have been installed. It has not been necessary to make any modifications of consequence to the conventional mine-type distribution equipment now available. Probably due to the added attention given the electrical equipment, very little difficulty has been experienced with it.

Other Mines

The Sandstone and Cliffside mines are being opened by duplicate circular concrete-lined shafts 12 ft 2 in. inside diameter divided to accommodate a five by eight-ft cage and a six-ton skip. A manway and pipeway are also provided. The shaft is partitioned with an airtight metal liner so that one side will be upcast and the other side downcast. One 125-hp underground fan will be provided at each mine. A 36-in. vent tube and escapeway is provided at each mine with an additional upcast fan. It is desirable to provide 100,000 cfm in the shaft bottom for each mine. A single hoist with a clutched drum will be used, and the cage and skip will be operated in balance. Both of these mines and the Ann Lee mine are equipped with slusher trenches and batch loaders in the shaft bottom. The power distribution system will be similar to that used in the Ann Lee mine.

MINING AT HOMESTAKE-NEW MEXICO PARTNERS

(Continued from page 46)

Water Flow Less Than Expected

Three shafts were then sunk into the water-bearing sandstone and it was quite rapidly determined that the assumption of the uniform or homogeneous sandstone aquifer was incorrect. The sandstone proved to have a much greater permeability horizontally than vertically—mainly due to the impervious shale and mudstone interbedding. This condition tended to slow down the drainage and decrease the quantity of water expected. Approximately 40 percent of the anticipated waterflow was encountered in the shaft sinking. As an example, it was anticipated that one shaft when bottomed would be making 1300 gpm. However, when it was bottomed it was making only 575 gpm. Information obtained during the drift development pointed more clearly to the discrepancy between the original estimates and the actual conditions.

At another mine it was estimated that after 3000 ft of drift had been driven the drifts would be making 2100 gpm. Actually at this point of advance the development drifts were making only 240 gpm. At the present time, with 15,000 ft of advance in this mine, it is only making 450 gpm.

As one would expect, the quantity of water each mine makes is quite closely related to the static head and the number of vertical fractures intersected. At the present time, all three of the mines are making substantially the same quantity of water

(Continued on page 50)

(Continued from previous page)

—that is roughly 450 gpm—although the development ranges from 1000 to 15,000 ft of drifting in these mines. Although everyone felt somewhat relieved about the water situation it is a little early to discount completely the fact that the quantity of water encountered could be a very serious problem in some of the mines in the district.

Numerous Problems Encountered

Even though the quantity of water has not been a big problem, the fact that water is present has certainly created many headaches. Two of the worst being the very dirty mine water and the sloppy, soupy muck handling. Each blast reduces a large portion of the rock to sand grain size. Since the uranium occurs in a sandstone which contains a fair amount of hydrocarbon, there is a portion of the fines in the muck piles which has a specific gravity very close to one. This material, when stirred by mucking, tends to float with the water. This has necessitated the use of settling ponds underground prior to pumping.

It is planned to try a classifier and a cyclone separator in place of the settling ponds at one of the mines. Even with the fair time in quiesient settling the water pumped still contains a number of tons of solids a day. It is not necessary to elaborate here on the pump maintenance other than to say that it is extremely costly.

An automatic sampler was placed on one mine pump discharge line, and tests were run over a period of one month. These tests indicated a loss of 12 lb of U_3O_8 per day as suspended solids. Much to everyone's relief no uranium of consequence was found dissolved in the mine water. To recover these colodial values a large settling pond was constructed on the surface. It is planned to add a reagent to the water to speed the settling.

The muck handling has been difficult especially where it is necessary to transfer it vertically. It flows too freely and out of control when water saturated; and when drained it bridges and packs. After trying chutes with no favorable results, draw points were installed using conventional muckers working at right angles to the haulage drifts. A temporary dam was placed in these draw points with a portion of the dam made of expanded metal covered with burlap. This acted as a filter and allowed the water to escape from the muck behind the dam. This scheme has been quite successful.

The sloppy muck also required modification on the skips, such as hoods to keep the muck from splashing out when loading and unloading. Rubber seals also were installed in the skips to keep the muck from leaking out.

Not all is bad with this sloppy muck. At times it is possible to slush out a drift round completely in two passes with a 48-inch scraper bucket, even though the haul may be 200 ft or more.

A great deal of sand accumulates in the bottom of the shafts. As much as 35 ft of shaft can be filled up in a week's time. To solve this problem in one mine, this sand is pumped with an electric, submersible, rubber-lined Swedish pump. This has been quite successful. In one mine it is necessary to muck the bottom each day with a Cryderman mucker. This is a temporary measure, but it is necessary to operate this Cryderman eight hr per day.

Pump All of the Ore?

Almost everyone visiting the district asks the question, "Why not pump all the ore?" This has been seriously studied, but it does not look feasible as it still would be necessary to haul the ore underground to crushers and pumps. Therefore, pumping ore would save only hoisting which has not been a big problem. Other factors such as dewatering the ore after pumping would be quite costly and complex. It is also anticipated that a great deal of the ore will be mined relatively dry.

In general, the rock conditions have been good with most drifts less than eight ft wide requiring no support other than occassional roof bolting. As areas are drained the rock tends to harden and strengthen. In a few areas it would appear that most cementing materials in the sandstone had been dissolved and lost. Miners call this "blow sand." To date this blow sand has been found only in very small areas and has not interferred a great deal with the mining operations.

As to mining methods, Homestake does not believe that it would be economical to stope large blocks of ground without first draining them. It is also felt that this can be best accomplished by placing the haulage and drainage drifts below the undulating ore. Therefore this method is being used in all three of the wet mines.

The method of attack has been to extend the haulage drifts as rapidly as possible, drilling vertical upholes during the advance to speed the drainage. The water level in the observation hole used during the initial water testing is measured each month. From this measurement it is possible to arrive at a good picture of the dewatered cone. In one mine about two-thirds of the ore is in the dewatered cone. This ore is being mined fairly dry—about seven to ten percent moisture. It is not sloppy.

It is planned to stope the thinner ore, four to ten ft in thickness, by use of a panel retreat method of control caving. This has been started in one drained area and is working fairly well. The stoping of the thicker ore, 10 to 90 ft thick, is still a question. It is possible that some of these areas will require the use of the cut and fill method.

From reports of various neighboring mines, it is rapidly becoming evident that there will be a great variety of water and ground conditions in each mine. Actually, to date mining men have only had a small peek at the tremendously large mineralized zone lying below the water table in Ambrosia. Another year of experience will add greatly to our knowledge of the intriguing mining problems that exist in this area.

HOMESTAKE MINING COMPANY
COMPRESSIVE STRENGTH TESTS OF DRILL CORE
(2¼" Diameter x 4½" Long Sandstone Core)

Core Identification		Moisture When Tested	Ultimate Compressive Strength
1 Hanging wall	As taken from core barrel	12.04%	1786 PSI
1 Hanging wall	Dried	6.25%	2540 PSI
1 Hanging wall	Dried	1.14%	2725 PSI
2 Hanging wall	As taken from core barrel	12.75%	1232 PSI
2 Hanging wall	Dried	7.14%	1899 PSI
3 Ore	As taken from core barrel	11.84%	2490 PSI
3 Ore	Dried	6.44%	2528 PSI
4 Ore	Dried	3.02%	3295 PSI
4 Ore	Dried & Re-saturated 2 hr	12.30%	2389 PSI
5 Hanging wall	Dried	3.20%	1861 PSI
5 Hanging wall	Dried & Re-saturated 2 hr	14.23%	1081 PSI

COMPRESSIVE STRENGTH TESTS RUN ON CORES TAKEN FROM THE AMBROSIA LAKE AREA EARLY 1957 PRIOR TO ANY MINING BELOW THE WATER TABLE.

Coil journal springs on gathering motors were replaced with leaf springs, with equalizers between the springs. This keeps the wheels following the rail and gives better traction. The new suspension system also cushions the jolts to the motor and makes it ride much easier

Backed by 25 years experience as chief electrician and master mechanic, the author describes a modern operation's preventive maintenance program, emphasizing the importance of having skilled operators and well-trained mechanics

Dividends from Maintenance

By JOHN L. HENLEY
Master Mechanic and Chief Electrician
Elk River Coal & Lumber Co.

THIS discussion of preventive maintenance, as it is practiced at Elk River Coal & Lumber Co., will deal with: (1) maintenance of substations; (2) rebuilding and maintenance of haulage locomotives and stationary motors; (3) rebuilding and maintenance of face equipment, and (4) a program for training maintenance men. In discussing these subjects, some helpful changes the company has made on various pieces of equipment will be described.

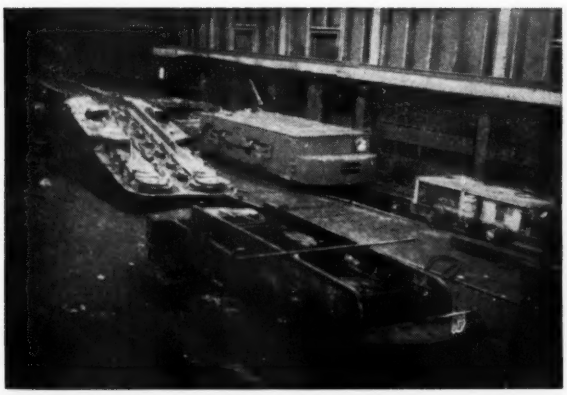
Maintenance of Substations

Elk River's electric power is purchased from Monongahela Power Co., delivered at 66,000 volts, stepped down to 4160 volts at the distribution station, and carried by about 20 miles of high voltage line to eleven 300-kw motor-generator substation sets. A static or ground line is used over the entire system with a ground rod at every fourth pole. Thyrite lightning arresters are mounted on the pole nearest the substation entrance, one arrester to each of the three phases. Before installing this lightning protection, frequent power failures occurred during the electrical storm season. Installation of these arresters has reduced failures due to lightning by about 80 percent.

Each of the substations receives a thorough inspection weekly. Brushes are checked to see that they move freely in the brush holders and are of the proper length. Automatic controls are checked to make sure the machine is not damaged by bearings overheating. Controls are such that a one-amp ground anywhere on the system will trip the oil switch. All relays and contact points are cleaned and checked. Any worn or damaged parts are replaced during the inspection. Also checked during this weekly inspection are fields, winding, commutator, coupling bolts, oil, voltage and load setting.

Every three months the substations are cleaned and blown out with compressed air at 60 lb pressure. The stations' insulation is checked by megger meter twice each year.

The regular systematic inspections of substations, with thorough cleaning and replacement of worn parts, has reduced Elk River's loss of time from power failures to a minimum.



Each piece of mine equipment is completely overhauled in the main shop at scheduled intervals

Haulage Locomotives and Stationary Motors

Haulage motors are 10 and 13-ton motors in tandem. These units are assembled in the company's own shop. Wooden bumpers were replaced with steel bumpers, which are riveted and welded on the motor frame. They have given more than ten years of trouble-free service. These bumpers are of hollow construction so that they can be used as air tanks, eliminating the old tanks that were fastened on the motor frames or wherever space could be found for them. Using a different type brake rigging and an extra brake cylinder, in addition to the original one cylinder, made the air brakes much more effective.

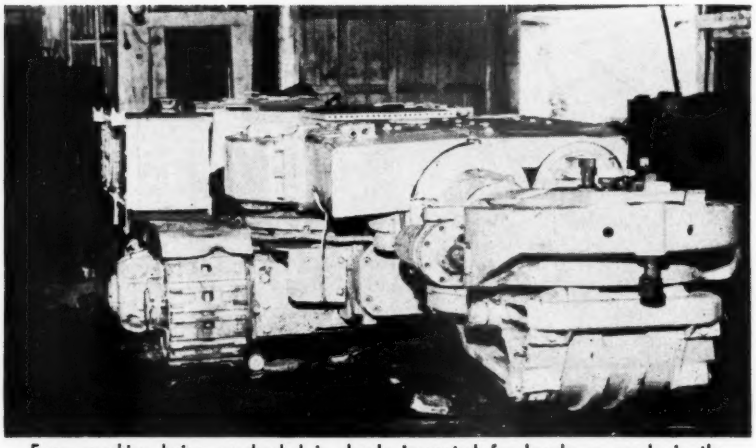
All motor units were rebuilt, with the field frame and bearing housing being built up, machined, and rebored. The two single axle caps were spliced together, making one solid cap, and four extra bolts added, which prevents ever having loose axle caps. Each main line locomotive is scheduled for a main shop check after every 24 hours of operation.

The gathering motors, five, six, and eight-ton machines, were rebuilt in the same pattern as haulage motors. However, because they have inside frames, a dust skirt was added, covering the outside of the wheels and protecting the motorman from dust. The motor top was extended to cover the skirt on each side of the motor, with pipe and hydraulic hose coming out through the skirt to oil the axle caps with a Hulbert oiler. The journal boxes are oiled through the end of the axle. This makes it possible for the motorman to do a better job of oiling and is much easier because he can oil without removing the top on the motor. The method has eliminated most bearing failures. Gear boxes are filled by the repairman when grease is needed.

Another improvement that was made on these motors was to remove the coil journal springs. The frame was cut out so leaf springs could be used, with equalizers between the springs. This keeps the wheels following the rail and gives better traction. It also cushions the jolts to the motor and makes it ride much easier.

The floating 1-type reels on these motors were causing a lot of trouble by burning collector rings because they had only one brush holder and brush. Another brush holder and brush was added on the opposite side, with leads going to both brush holders; thus, a good connection was provided between brushes and collector ring at all times. Much of the trouble was eliminated and the system works very satisfactorily.

Experiencing trouble with the ribbon-type blowout coil on the controller, the company wound, in its own armature room, blowout coils with ¼-in. square glass 1-insulated magnet wire, two turns parallel. The result was excellent service from these coils.



Every machine being overhauled is closely inspected for breaks or cracks in the frame and housings, and all parts are checked for damage and wear

The main shop rewinds and repairs about 90 percent of all armatures and field coils used by Elk River. Experience has shown the importance of having the best insulation on armature coils. This adds a lot of service life to any armature; consequently, only the best grade of glass BBBX insulated coils are used for winding. The armatures are dipped in baking varnish and baked at 212° F for 12 hours.

The fields that go in any unit or motor are carefully tested to be sure they are in A-1 condition, both by visual inspection and by ohmmeter reading. Comparison is made with a new field of the same type. Fields that are partially shorted out between turns will cause excess heat and armature failure, because what is a normal load on a motor with good fields will be an overload if the motor has one or more fields with shorted turns. It happens quite frequently in mine shops that armatures are changed without checking the fields. This is a sad mistake, because properly balanced fields are as necessary as a good armature. In testing the fields with a field tester, the company found about 80 percent of its old fields to be defective. These were dismantled and reinsulated, and before being put back in use the reading on these fields was the same as on new ones.

Face Equipment

Each piece of mine equipment is on schedule for complete overhauling and rebuilding in the main shop. A complete service record is kept in the shop office of each piece of equipment, identified by Elk River's number and the manufacturer's serial number. By these records, management knows which motor, pump, loading machine, shuttle car, cutting machine, and so forth, is next to be overhauled. The company has one motor, one cutting machine, and one loading machine in the shop in process of being overhauled at the same time.

Overhauling begins by cleaning the machine with steam furnished by a steam jenny. The machine is then completely dismantled and again cleaned, each piece separately. It is closely inspected for breaks or cracks in frame or housings. The parts are checked for damage and wear. An itemized memorandum is made as the inspection proceeds. At the end of this inspection the company knows what parts will be needed and can figure the over-all cost to rebuild the machine and put it in A-1 condition.

In rebuilding, if a weak part is found in the frame or housings, it is reinforced and made more substantial than it was originally. The machine is then checked for performance to see that it operates correctly. At the finish of the job, the machine is given a fresh coat of paint, which not only preserves the metal but gives the operator an added sense of pride in his machine and encourages him to handle the machine more carefully.

The repairman on duty on each working section each shift inspects contacts, crawler-type chains, sprocket chains, and machine and shuttle car tires. He also makes a thorough check to see that the machines are properly lubricated. Temporary repairs are made if necessary during the working shift. Permanent major repairs are made on off shifts, at which time the equipment is thoroughly checked for any worn or damaged parts. It is part of the repairman's responsibility to see that the machines are not unnecessarily abused and are properly operated.

Training Maintenance Men

Elk River's maintenance men are largely selected from high school

(Continued on page 64)

Role of Staff Functions in Management

By TOM WARE
President
International Minerals & Chemical Corp.

Unlike the "one man" organizations of the past, today's corporations must depend upon coordinated human effort and full use of all available talent to withstand the growing pressure of aggressive competition

Broad staff services fill a real need in helping a corporation meet its citizenship responsibilities in remote mining locations. At Esterhazy, Saskatchewan, staff planning helped the 700-person community meet the shock of sudden expansion. An advance tax payment helped finance the new school in the background above. New homes (foreground) built by IMC in the prairies adjoining the town took care of personnel moving into the area, and extra lots were made available to interested townspeople. Sewage, water, and service utilities were all part of the over-all planning to facilitate the company's entry into the community

IF there is one feature that seems to set apart men in mining from those in most other industries, it's an unusually strong sense of accomplishment. There is nothing quite like the spirit that pervades the air in the mining industry, where people do things on a big, big scale providing the source of most of the basic elements for living and even those necessary to life itself.

There's real pride in accomplishment. To locate ore is a feat in itself. It takes work in every branch of science to turn up telltale clues. And once ore is located and evaluated, its processing into satisfactory economic payoff is another major feat. Success in these efforts calls for creative talent as never before, especially in view of today's fast rate of depletion of many high grade ores.

To get good people to run mines, most often at remote geographic locations, and team them up effectively is still another feat. Finally, there's the challenge of planning, operating and controlling mines, operations which must produce in great volume to obtain even a reasonable return on huge investments. All of this is further evidence of the unique magnitude of daring and accomplishment in this industry.

Yet, despite all this, the mining industry frequently is described by outside observers as too conservative!

How much of this criticism is justified?

Now, the author knows the magnitude of mining problems from years of active association with them. Yet he is enthusiastic enough about mining's future to wonder if the job we do is good enough. And he wonders whether we use a proper base when we measure job accomplishment.

Are we, in fact, too conservative? Too conservative in exploration for new minerals? Too conservative in

our study and adoption of new organization planning? Too conservative in too many phases of this complicated and challenging industry?

A look at some of the conditions and situations in our industry might help us to answer those questions. Take today's competition, for example.

Today's Competition

Our competition today comes from any but traditional and conservative sources. Copper people don't compete exclusively among themselves any more—they have aluminum competition to think of, too. Steel people also have keen competition from aluminum, even if they still feel there's nothing quite like steel. Plastics and glass producers take on all comers. Our Chilean neighbors in the sodium nitrate business must now compete with ingenious producers of solid nitrogenous materials, who reach into the air and produce marketable substitutes with chemical magic.

Ingenuity for developing new sources of materials is clearly on the rise everywhere. This is an age of keen challenge, an age for research efforts of fantastic proportion. It's an age of fast communication of hot ideas, and fast translation of those ideas into reality. It's an age of quickly shifting product preferences, a time when no segment of our economy can afford to pause for self-congratulations, least of all the mining industry.

Let's wax philosophical just a moment on the role that man and his ingenuity play in the creation of this competitive atmosphere.

Man's ingenuity, his imagination, and his drive have made it possible—made it almost commonplace—for industries to explore competitively and profitably the side paths along the main road they've been traveling for years.

Man's value has risen so much in our economy that outside of mining he has become a number one factor in the diversification, expansion, and increased profitability of one major industry after another.

There are no longer traditional barriers to keep a company in any given field of industry. Even countries vie for shares of opportunity to meet their economic needs and satisfy their peoples' wants; wants that are whetted by radio, movies, television, and now jet transportation communication!

Thus, managements everywhere are running into more diversified and intensified competition. And management in mining, specifically, is on the spot to provide new leadership—new in talent, new in attitude. Today's companies can no longer rely on the ingenuity and energy of one man. They must now turn to a competently planned organization, to the combined brains and abilities to be found in well-conceived staffs of specialists. Experts of high order are needed to heighten the capability and reliability of management leadership, although, to be sure, risk-taking always will be a part of mining.

The staff specialist in business today acts as an aid to management in its fundamental responsibilities of planning, organizing, integrating, and measuring. The process by which the staff engineer functions in balance with marketing, finance, research, public relations, and all other specialist functions is extremely complex. More than any other aspect of management, this one brings into focus the role of an executive as a professional manager of men and a coordinator of human effort. Herein lies the major difference between the "one-man" operator of yesterday and the successful executive of today.

Winning Creativity

One of the major jobs facing management today is the establishment of an atmosphere for creative accomplishment, the winning of a *condition for creativity.*

This creative atmosphere, developed through staff, is what it takes to turn up the pluses that will make a business thrive competitively and grow. The staff engineer does his part by developing his technical staff unit to a high degree of perfection and efficiency of purest functionalism. Engineering in this sense constitutes an important source of ideas for management, by probing the range of its specialized knowledge. Under these conditions, more precise fields of technical specialization, with which the mining industry may have had little experience, now come into profitable play.

Kennecott, for example, has a recognized department of Industrial Engineering, which is making a significant contribution to more effective and profitable operation. Statistical quality control methods are also beginning to yield good results at Kennecott. Anaconda, in the field of materials handling automation, and cost control, has found that the application of systematized engineering planning has paid off. Instrumentation, with its concomitant of automatic control systems, and even the highly technical field operations research, are other examples of the special services from an engineering staff that are paying off where it counts—on the P & L sheet.

The role of staff in management at International Minerals & Chemical Corp. is quite broad, and it gives the company the basis for continued sound growth in both its present and new marketing areas. IMC now pro-

Specialists from many staff units contributed to the long-range planning behind IMC's entry into the rich new Canadian potash field. Shown here is a view of the mine site at Esterhazy, Saskatchewan. Headframe, mill, and service facilities are now enclosed and the mine is scheduled to go into operation in 1960

duces 57 products, among which 19 have a major share of their markets and hence constitute the keenest competitive responsibility. The company mines and produces 19 different nonmetallic minerals, which are either used by industry as beneficiated, or modified to suitable form through chemical processing means. It manages to handle 13 different marketing and selling campaigns ranging all of the way from minerals for industrial manufacturing operations to specialized chemicals serving the electrical industry. The company sells at all marketing levels and exploits every known channel of distribution. Underground and above ground mining is conducted under highly competitive conditions. Bulk chemicals for the agricultural market and chemically pure food products for animal and human consumption are manufactured or refined.

These things are mentioned just to give you an idea of the wide range of the stresses that IMC's management can experience as typical of a multi-divisional, multi-product organization.

IMC is organized along product lines, having five operating divisions. Each operating division constitutes a business and profit center. A vice president heads each of these divisions.

Supplementing the operating division part of the organization, the company has integrated quite broadly with many staff specialty services. The staff units serve not only divisional needs, (72 plants spread throughout the U.S., Canada and Mexico), but they serve corporate needs as well. Such staff functions as purchasing, treasurer, controller, legal counsel, and corporate secretary are standard in almost any corporation today. But from there on it is found that the complex character of IMC's business demands specialists in mining and exploration, transportation, industrial relations, (personnel, labor, supervisory training and placement), tax management, insurance and safety. Engineering which is found at any plant level also has its counterpart, yet, in distinctly separate form, on the corporate level. Recently, the company has added a marketing staff that offers a full line of specialized selling talent in such areas as market research, market development, market services, advertising and sales promotion. Finally, it has recognized public relations as a valuable tool and aid, not in the old fashioned sense of hucksterism, but in a vigorous, fresh, new sense of seriously helping out in all fields of communication from plant community level to the promotional and selling level. Public relations staff people may offer a broad range of services — from a general program designed to help develop a corporate profile with the company's many publics, all the way to a very specialized service, such as helping settle an emotional community problem.

Organization Maturity

Organizational maturity, achieving a balanced integration of services of this breadth and scope, requires a great deal more than mere specialized training on the part of staff and a knowledge of line responsibility in operating departments. It starts with the quality of personnel — and it ends there too.

Integration of staff services with the line portion of an organization can be at once one of the most difficult of tasks for any management and the most rewarding. As a source of new ideas, staff can be stimulating, invigorating. Staff can give a management wings in problem areas by pulling together the facts, where it has the freedom — as no other group has — to concentrate exclusive of all else on that one problem. Staff can also constitute an important area of training opportunity, where one can gain a perspective of the whole of an enterprise. But staff's biggest difficulty seems to come in the frustration of wanting to feel a sense of accomplishment, when it knows that the doing and the decision-making belong with the line part of the organization. Corporate staff people, to be competent in such circumstances, need to have breadth and enough of the generalist background to give proportion and perspective to what they can do for an operating department. They also need to be on guard against their most characteristic difficulty of tending to be too theoretical and too specialized.

Operating department people, on the other hand, need an open mind that has a broad conceptual capability for maximum compatibility with staff. True managers will use staff to learn, to make gains in given fields of specialization where they may otherwise have little opportunity to do so. If they are broad enough managers, they can anticipate probable areas of misunderstanding and so help staff through these to accomplish their mutual desires. But above all they must be mindful of their responsibility to keep on top of any management situation by not allowing staff to make their decisions for them, by not opening themselves to the pressure of domination by staff, and by anticipating problem situations far enough ahead so that they don't misuse staff as a fire brigade service.

Objectivity

There is still no substitute for leadership, no matter what the devices to augment management's abilities to plan and achieve its goals. The greatest single difficulty in achieving the maximum harmony — profitability — in any organization lies in an appreciation and sensitivity to human values in the corporation, which after all is a social institution. Human drives for a personal sense of accomplishment call for tactful appreciation, and no matter what the organization form, it can only click with a clear sense of objectivity, a well delineated plan for getting there, and a fair measurement system which tells everyone in the program how he's doing.

But to sum up, management today is called on to answer many of the same questions as its predecessors with many new ones peculiar to our times and today's politics. The business is much larger, more complex than ever before. But if there is any doubt in your mind that broad team effort is needed in the multi-million ton mining enterprise, consider these few questions which most such managements face:

1. What should be our long term growth objectives?
2. What is our desired position within the industry with respect to reputation and share of available business, and how well are we doing here anyway?
3. What measures are needed to provide the research and development program necessary to achieve company goals?
4. Is our plan of organization keyed to our objectives and is it adequate?
5. Is there proper balance between research expenditures for process improvement and research aimed at finding totally new products for new markets?
6. Is our knowledge of trends within our market clear enough so that we can plan to capitalize on these trends?
7. Are any changes needed in pricing policies or channels of distribution?
8. Are there any respects in which trade and customer relationships need strengthening? Do we offer unique, specialized services that are valuable to the customer, that really make a difference in our selling program?
9. Are processing facilities adequate for the present and immediate future? Are they the most efficient in our industry?
10. Have we a truly competitive selection process for the assignment of capital among our plants or operating divisions? Does it really work? What is our standard for minimum acceptable return on investment?
11. Do we have a sound, current labor policy?—Long range too?
12. Do we really plan for profit in all departments, or do we rely solely on market opportunism?

These are but a few of the questions to which today's managements must have the right answers. In attempting to reach intelligent answers to the foregoing questions, IMC has found the role of staff, as the author has outlined it, to be a valuable, even indispensible, aid to management.

Analysis of Service Haulage Behind Continuous Mining Equipment

Will the mines of tomorrow employ such equipment as self-propelled shuttle cars, gas-turbine powered equipment, trolley conveyors which combine the better features of both mine cars and belts, and extensible belts designed for a total extended length of 2500 ft? The author points out the limitations of existing haulage systems and the steps necessary either to modify basic types of equipment or to replace existing types with new concepts

By GERALD von STROH
Director of Mining Development
Committee
Bituminous Coal Research, Inc.

RUSSIA has under development a coal mine to produce 6,000,000 tons of coal per year; the entire mining operation to be handled by one operator who will watch a television screen and control coal cutting from a single panel. Whether or not you believe this unsubstantiated report, the fact cannot be ignored that both the United States and Russia have the technical know-how to achieve these aims.

If Russia can produce sufficient coal to supply the requirements of Europe and other parts of the world, she will have in her hands a more potent weapon for The Cold War than a half dozen sputniks circling the globe.

Russia has apparently realized the economic importance of coal and the manner in which it can influence world conditions and trade. This work it is proposing to do will require expenditures in terms of billions of dollars. Under consideration by Congress is a bill amounting to a few million dollars for coal mining research—small compared to, if you please, its appropriation for atomic energy.

Basic vs. Applied Development

In view of the preceding, can the U. S. coal industry afford to consider any phase of continuous mining exclusively in the light of today's needs and problems and ignore the needs of the coal mine of tomorrow?

For example, in the consideration of service haulage, shall a system be evolved which is only competent to handle today's average per shift range of 200 to 1200 tons per shift or shall the system inherently be capable of handling tomorrow's better than 4000 tons per shift per machine average.

Admittedly, it would be difficult for anyone producing between 200 to 300 tons per shift per machine to even comprehend production units producing 4000 tons.

This is the area of basic misunderstanding between those in applied development and those in basic development. The writer does not know of any coal operator who would say that he was against research and development but the individual operator's idea of research and development goes from the extreme of "yes, we are doing research. Why, only last week one of the manufacturers sent us a new drill and we tried it out."

The opposite extreme consists of companies who support a cooperative industry basic research and development program and who at the same time, maintain a very substantial staff and organization for doing applied development at the mine level. They utilize as rapidly as possible the information and data provided by the Mining Development Committee of Bituminous Coal Research, Inc.

Obviously, the latter situation is more ideal, but unfortunately, such companies represent only one half of the industry.

The fault for this situation does not, of course, lie entirely with the operator. Those in basic development have failed to present to the operators a challenging program in terms which they can use to justify taking money for this purpose from profits.

However, since it is the Mining Development Committee's obligation

to work toward the mine of the future, this analysis of service haulage for continuous mining must be pointed toward production per machine unit of the foreseeable future.

16,000 Tons per Shift Machine Under Active Development

Under active development by the Committee is a machine with a theoretical capacity of 16,000 tons per shift per machine. At present, a 20 percent operating factor is obtained from currently available continuous mining machines. While it is hoped that the operating factor with the new concept will be better, it will be presumed, for this discussion that the operating factor will remain constant. Therefore, the 16,000 tons per shift machine, on a 20 percent operating factor, will produce 3200 tons per shift.

With a transportation system which in principle is competent to handle 3200 tons per shift, a substantial improvement can be expected in the production of any existing continuous mining machine using this system.

It becomes obvious that any service haulage system must operate on a two-way basis and as will be discussed later, the handling of supplies might prove to be a bigger job than hauling the coal.

The tons per shift must, of course, be a major factor. Careful studies of mine car and belt haulage, with coal being discharged from a boom point at the rate of 3200 tons per shift, indicate that for mine car haulage, even with panels on 1200 ft centers, the main line would need to be triple tracked and even then the supply problem would be critical.

Belt haulage would present even a more severe supply problem and to handle surges, more than one section would probably require at least 60-in. belt lines.

The Problem of Handling Supplies

It is interesting to note that a recognition of the supply handling problem was one of the major reasons why the Mining Development Committee evolved a program of utilizing foam to control dust and to eliminate rock dusting at the working faces.

It requires roughly 100 bags of rock dust for a 300 ft room. In order to mine 3200 tons in a shift, it would be necessary to drive about 1600 ft and this would require approximately 500 bags of rock dust. It is quite possible that, in order to achieve 3200 tons per shift, at least two machines would be needed to operate in parallel, so that over a panel heading it would be necessary to handle roughly 1000 bags of rock dust per shift.

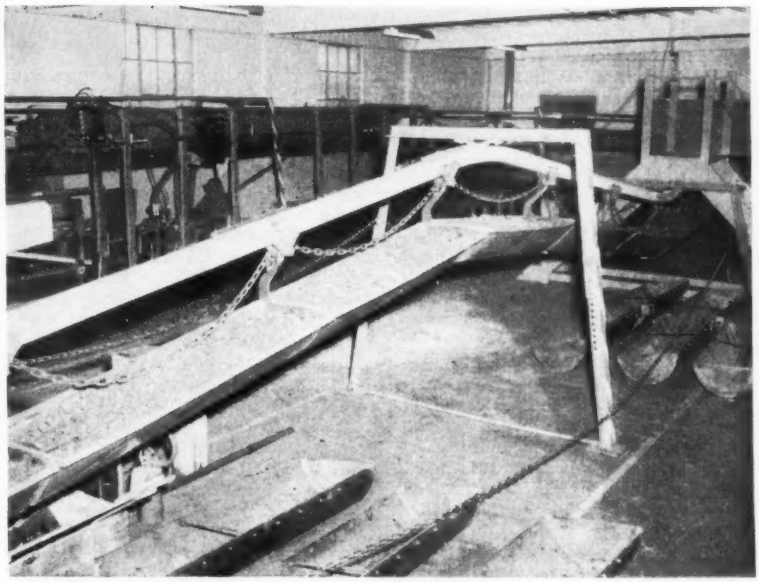
This indicates the desirability, if rock dust is to be used, of having on the surface a large storage silo and pneumatically conveying the rock dust to the working places as required. Some very fine work in basic studies of the pneumatic pumping of rock dust, both on a wet and dry basis, has been done.

The use of foam to replace rock dusting in the actual working places appears most promising, not only as a means of eliminating the congestion in the working places but also as a very effective means of reducing or eliminating the coal dust problem.

The Committee's temporary roof support system, wherein the material necessary for roof support can be carried with the machine and/or stored in adjacent break-throughs, should further help the supply problem.

Work being done by the U. S. Bureau of Mines, and to a lesser degree by the Mining Development Committee, of gluing together of the roof strata, might conceivably eliminate this as a supply problem in total.

The author has tried to hit the high spots of some of the problems. Space does not permit going into various details of their solution. In principle, the Committee can see as a practical measure the following.



The MDC Trolley Conveyor, with a capacity of 2500 tph, can operate on grades up to 60°

A Trolley Conveyor for Main Line Haulage

For main line transportation, the Committee's trolley conveyor has a capital cost substantially less than mine cars or belts but is competent to handle at least a 50 per cent greater payload. The system combines the better features of both mine cars and belts. It has the continuous feature of a belt, yet has the ability of the mine car system to handle man power and supplies. It can be extended readily and once installed, as compared to either track or belt, should be relatively low in maintenance.

From the main line to the room entry or the length of the panel heading, the Committee's extensible belt may be used. This extensible belt differs from those commercially available in that it has fewer moving parts, therefore, it is cheaper. In the same storage space, the unit can store approximately ten times the amount of belt. For example, the first full scale unit will be extendable in 500-ft increments as compared to 50 ft for commercially available extensible belts. The unit is being designed for a total extended length of 2500 ft.

Incidentally, the Committee is in an area wherein the mechanical development is somewhat ahead of belt development. As soon as a belt splice is developed for thinner plys of belting, with tension loads up to 2500 ft, the same drive, storage box, etc., without any changes whatsoever, will handle the full 2500 ft of extensibility without adding any belt.

This particular development is significant in many respects. It is the result of the very careful analysis of the problem of service haulage by BCR's Face Transportation Advisory Group and in its considered opinion, the first area to be attacked was that of panel transportation. This is something which would fit the long range requirements of the industry and, at

the same time, permit more effective utilization of existing transportation systems between the panel heading and the continuous mining machine.

It is believed that shuttle cars cannot be properly evaluated until conditions more ideal for shuttle cars are made available. An extensible panel conveyor will permit maintaining a minimum length of shuttle car haulage.

Cableless Shuttle Cars

In the area of transportation immediately behind the continuous mining machine, the Mining Development Committee is investigating two systems. One is shuttle car systems, but with cableless shuttle cars. The State Legislature of West Virginia has passed a new coal mining law which permits the Committee to realistically consider gas turbines and internal combustion engines as a means of propulsion for shuttle cars.

Elimination of the cable reel and the use of new mechanical devices permit thinking in terms of a shuttle car of about the same capacity as those currently being used, but narrow enough to permit two shuttle cars along side of each other in an entry. This would allow having one shuttle car always under the loading boom of the mining machine. Once the trailing cable has been eliminated, the wonderful flexibility of a shuttle car system really comes into its own.

Possible adaptation of newly developed shuttle cars, such as those hinged in the middle and narrow in width, could possibly mean that a shuttle car system by itself would be adequate between the continuous mining machine and the panel belt previously described.

Extensible Belt Drive Mounted on Boom of Continuous Mining Machine

Also under consideration is an extensible belt utilizing one and two-ply belting whose drive and storage unit would be mounted directly on the loading boom of the continuous mining machine, very much like the bridge conveyor currently being used, capable of being extended for distances of 50 to 80 ft. The Committee would contemplate a steel trough, wound on a spool in place of the conventional idlers.

Another lightweight, almost identical unit, except for self propulsion, would be used to provide another element of flexibility. Once the 2500-ft unit is successfully tested, a 300-ft unit would be relatively simple.

The major element requiring basic development is an idler which automatically fits in place and retracts as required. This would eliminate the two men currently required for setting and removing idlers. Fundamental work in this area has progressed but is being held in abeyance until the full scale, 2500-ft unit is out of the way.

Coal Mine of the Future

The predictions for the future, which the writer as an individual is willing to make, are not necessarily agreed to by the Mining Development Committee, members of the staff or members of the Advisory Groups. They are as follows.

Strip mining, as it is now known, will cease to exist. Utilizing the techniques for driving tunnels at the Oahu Dam in South Dakota, 50 ft diameter galleries will be driven on one-mile centers. Driving the galleries will cost about ten cents a ton of coal recovered. Operators having 200 ft of cover or less would open up trenches with a dragline, on one-mile centers, instead of driving galleries with a machine. With 50 in. of coal, cost of the trench would be about ten cents per ton of coal recovered. The machine unit which would recover the coal between the galleries would be quite similar to that developed by Union Carbide Chemical Co., utilizing the new concept of mining machine now under development by the Mining Development Committee. It would provide a rate of advance in the order of 20 fpm, thereby giving a theoretical production rate of better than 8000 tons per shift. A conveyor to go a mile has been achieved in other areas and certainly the one currently used by Union Carbide Chemical would do so.

Directional control and guidance of such a system is, of course, a major problem but the Committee has made very substantial progress along these lines and there is reason to believe that the solution will be achieved before the over-all system is available.

When the machine has driven the one mile to the next adjacent 50-ft wide gallery, the machine can be turned around and headed back in the opposite direction, leaving a six-in. fender. The machine would be connected to a second conveyor so that one of the serious losses of production by back tramming would be eliminated.

A machine which operates only in a straight line and only in one direction would be simpler and lower in maintenance than those now being used.

With a 50-ft diameter gallery being paid for at the rate of ten cents a ton, there is the height and space to think in terms of primary preparation underground, such as a Bradford breaker, picking table, or its equivalent, so that coal mines now having a reject delivered to the preparation plant would substantially reduce this and eliminate much of the cost of present gob piles.

Chemical cleaning and drying systems will permit much higher percent of recovery from the run-of-mine coal, so that material rejected underground or on the surface will contain essentially zero coal. Of course, a market must be developed for minus 200-mesh coal before this becomes a commercial possibility.

In many respects, this coal mine of the future is basically only waiting for the operator with the courage and patient capital to do it. The gallery driving machine already exists and it is interesting to note that the tunnels driven at the Oahu Dam encompassed two coal seams. Therefore, the material through which these tunnels were driven, for all practical purposes, is the same that is found around, above, and below our present coal seams.

Any competent coal mining machinery builder could develop and design a machine at a relatively low cost to mine the coal in a straight line and because the machine would not come back out of the same hole, the requirement for retractability would be substantially less.

Because no man power would be going inside the hole, requirements for rock dusting, ventilation, and roof support would be substantially reduced.

Cost of Proposed System

A time and cost table for such a system is not too difficult to approximate.

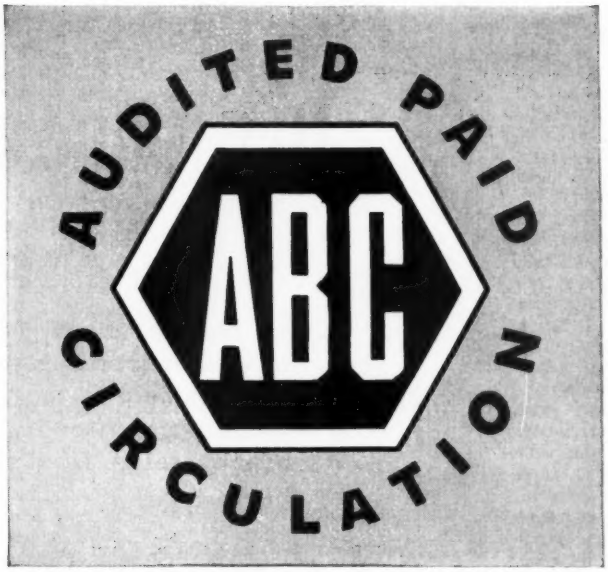
If we were to start now with adequate but not excessive funds, the first experimental unit could be in service within two to three years and full commercial production two to three years after that, or in full production by 1963 at the earliest, 1965 at the latest. When you consider that it requires from three to five years from the start of the engineering of a coal mine to having it in full production, the time schedule is not out of line.

The cost of such a development can be estimated on the basis of what parts are available and what parts need further development.

2 gallery machines at about $500,000 each....	$1,000,000
2 mining machines at $250,000	500,000
12,000 ft of conveyor at $200/ft	2,500,000
Total	4,000,000

The total is probably less than the cost of a large stripping unit, which would include trucks, coal loader, stripping shovel and drills.

This proposed system would produce 16,000 tons per shift or 32,000 tons per day (two shifts) for an annual production of about 6,000,000 tons—less than $1.00 investment per annual ton of production. This is substantially less than the investment cost of any existing large system.



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MINING CONGRESS JOURNAL

A.B.C. REPORTS — FACTS AS A BASIC MEASURE OF ADVERTISING VALUE

Dry Concentration of M

By P. E. Cavanagh
Vice President
Premium Iron Ore Ltd.

Results obtained in a 1 ½-tph pilot plant on a variety of ores point to the possibility of substantial savings while achieving concentrate grade and iron recovery at least equal to results from conventional wet flowsheets

A PILOT plant has been designed and built by the Ontario Research Foundation of Toronto, Ont., for dry grinding and magnetic concentration of low grade magnetite ores. This plant has now been in operation for one year, and has processed tonnage samples of ten different ores. These ores varied considerably in iron content, grain size and other mineralogical characteristics. The results so far indicate the possibility of obtaining at least as good grade of concentrate and recovery of magnetic iron on many ores as would be obtained with crushing, wet grinding and wet concentration of the same ore.

The pilot plant has a nominal capacity of 1½ tph of ore feed and can treat minus eight-in. mine-run ore. Figures 1, 2, 3 and 4 show the pilot plant equipment.

The basic flowsheet for all tests is shown in figure 5. This flowsheet can be modified as necessary depending upon the characteristics of the ore, since it may be desirable to repass any concentrate or tailings several times to improve grade or recovery, as is usual practice in any concentrator. It is also possible to split the ground product from the Aerofall mill

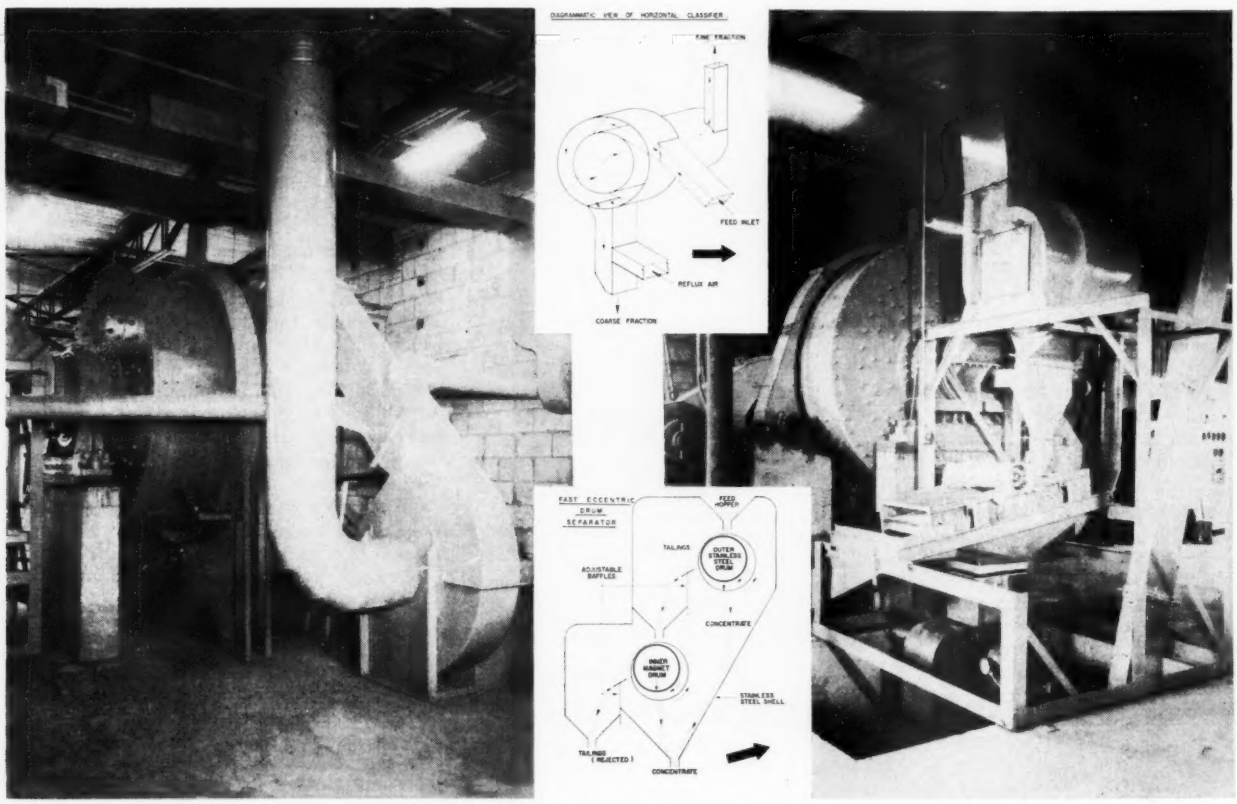

Fig. 1. (LEFT) Shown here is the autogenous Aerofall mill, main blower, and secondary air system. The mill grinds dry, is 6½ ft in diam and has a capacity of 1½ tph. Fig. 2. (RIGHT) The horizontal classifier takes +150 mesh material out of the air stream from the Aerofall mill. This coarse fraction is screened to remove +20 mesh. The −20/+150 mesh fraction passes downward to the Fast Eccentric Drum separator. The concentrate from the second drum is either returned to the mill for further grinding, or passed over a third drum to give a finished concentrate, depending on the type of ore

Magnetic Iron Ore

into more than two size fractions to improve the efficiency of the magnetic separators.

The optimum performance will be obtained from these separators when they are fed with a known and controlled size fraction of the ore, and are adjusted to give the best results on this particular size fraction.

Test work has demonstrated that, apart from the obvious advantages of a completely dry operation in very cold or very dry locations, there is the possibility of considerable savings in operating costs of such a dry concentrator when compared to a wet concentrator operating on the same ore. It is estimated that savings in operating costs can be as much as 20 percent of the cost of processing ore from the primary crusher to a finished concentrate.

Description of Equipment

The **Aerofall mill** is an autogenous grinding air-swept mill. The Foundation's 6½-ft diam pilot plant model is driven by a 50-hp, 550-volt induction motor, and has a constant speed of 26 rpm. The power drawn by the mill when empty is five kw, and under load varies between 15 and 20 kw according to the ore used.

The mill feed is loaded manually into a skip which is raised to the feed hopper by an electrical hoist. The maximum feed rate obtainable by this method is limited to a little more than 6000 lb per hr, but with very friable coarse-grained ores, the mill could no doubt handle a considerably greater feed rate.

The mill is fed from the hopper by a Syntron vibrating feeder, and the feed rate is controlled electronically—either by the power drawn by the mill or by the intensity of sound in the mill.

The ore charge in the mill is essentially self-grinding and can be reduced from a maximum of eight-in. run-of-mine material to as fine as almost 100 percent −325 mesh in a single operation. The fineness of the grind required is controlled by the air velocity through the mill.

In some cases, a number of six-in. diam steel balls, weighing approximately 30 lb. each, was added to the mill charge to increase the grinding rate. These balls were used especially with very soft ores, very hard ores, and fine-grained ores. The largest number of balls used in any test was 35.

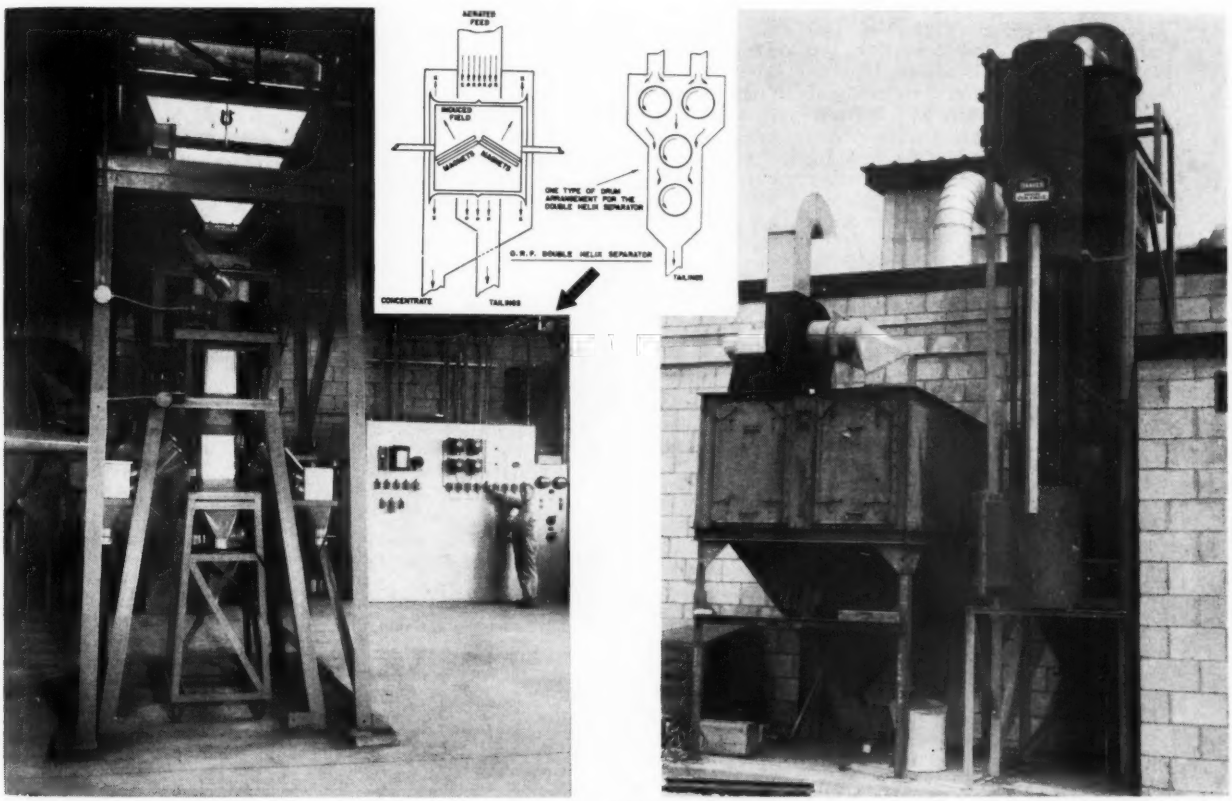

Fig. 3. (LEFT) The −150 mesh material from the mill is transported by the air stream from the horizontal classifier to a Cyclotrell dust collector, and thence to the Double Helix separator. Fine concentrate discharges through eight hoselike ports from the separator, while tailings continue on through the dust flue. Fig. 4. (RIGHT) The Cottrell electrostatic precipitator at the far right collects primary fine dust from the Cyclotrell. The Sly bag filter collects secondary dust from air which has been withdrawn from the Cyclotrell and passed through the Double Helix

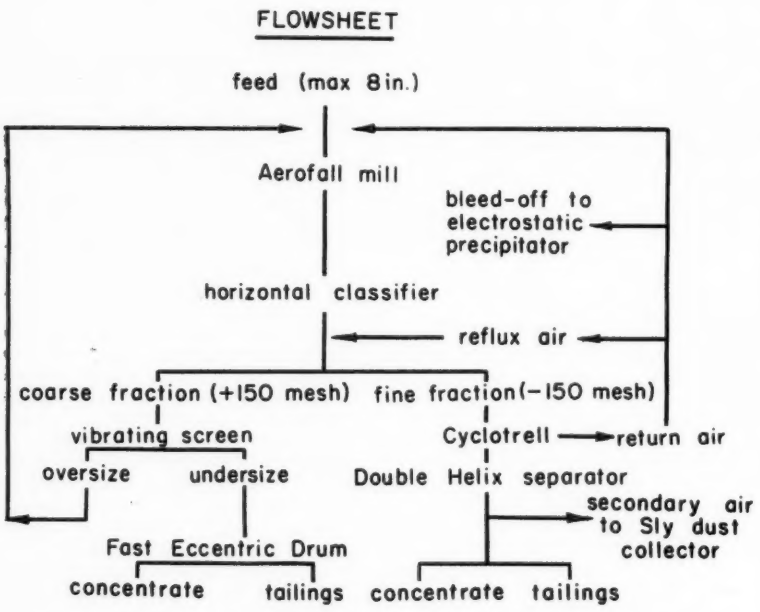

Fig. 5. Basic flowsheet used for all tests: this flowsheet can be modified as necessary depending upon the characteristics of the ore

The **horizontal classifier** is intended to separate +150 mesh material from −150 material. The design of the classifier (see upper schematic diagram adjoining figure 2) consists of two concentric cylinders on a horizontal axis, one of larger diameter than the other. The dust-laden air enters tangentially at the top of the larger cylinder and is swept around the circumference. The coarse fraction drops to the bottom of this cylinder, while the fine fraction is swept through to the smaller cylinder and exits tangentially into a vertical up-duct.

During the earlier tests of the pilot plant, this classifier did not operate efficiently, as a considerable portion of the coarse fraction was blown straight through, apparently not following the circumferential path intended. To prevent this, the smaller cylinder was extended into the larger cylinder. A marked improvement was observed, but the efficiency of separation was still not high enough. A hinged baffle was then welded inside the classifier entrance in an attempt to direct the air stream into the circumferential path. This again brought about an improvement, but it is felt that still further modification is required to produce the desired efficiency of classification.

The reflux air supply, which is drawn from the return air stream by a small fan, is introduced at the bottom of the classifier. Adjustment of this air supply controls the amount of fines in the coarse fraction.

The **Cyclotrell** is a multi-cyclone type of air classifier, designed by Research-Cottrell, Inc., of Bound Brook, N. J., for the collection of fine dust. There are nine tubes in this classifier. The particular model in the pilot plant circuit is of a size intended for considerably larger feed rates than those produced in the plant, and the dust collection is therefore not as efficient as it should be. During one test, three of the tubes were blocked off in an attempt to improve the collection, but no appreciable improvement was observed.

The **main fan** is an exhauster rated to give a maximum of 7000 cfm 13.5 in. wg at a speed of 1700 rpm. The fan is driven by a 25-hp, 550-volt induction motor. A baffle controls the draft on the output side of the fan, and draft readings are taken by means of a manometer at the input side. As the dimensions of the mill trunnions are constant for all operation, the air draft is proportional to the velocity of the air passing through the mill. For the sake of simplicity of operation, draft measurements rather than air velocity measurements were therefore taken as a control on the fineness or coarseness of the grind. During the tests, drafts varying from 1.8 to 8.0 in. wg were used. Drafts higher than 8.0 in. wg produce a grind too coarse for the purposes of the pilot plant.

Although the circuit is designed to be as air-tight as possible, there is an excess of air drawn into the circuit at various leakage points. To offset this and maintain a balance of airflow, a portion of the main air stream is constantly bled off. This bleed-off air is drawn by a fan through the **electrostatic precipitator.** The latter is also designed by Research-Cottrell, and serves to remove the dust from the bleed-off air, while discharging the clean air to the atmosphere.

The secondary air supply to the Double Helix separator (see below) is supplied by a fan mounted on the **Sly dust collector,** which is a multiple cloth filter. The aim of this secondary air supply is to keep the Double Helix feed discharging from the Cyclotrell in an aerated condition, and also to draw off −325 mesh dust. An airflow of approximately three cfm per lb. of Double Helix feed is sufficient to maintain this condition.

A branch duct from the Fast Eccentric Drum (see below) is also connected to the Sly dust collector in order to remove dust from this separator.

The **magnetic separators** used in the pilot plant circuit have been developed by the Ontario Research Foundation, and patents for the equipment are licensed to Research-Cottrell.

The magnetic separators use a rotating magnet drum, outside of which is an independently rotating stainless steel drum operating at a different speed. Drum speeds of 200 to 400 rpm are used to approach, as nearly as practical, the treatment of

TABLE I
TEST RESULTS ON SOME SELECTED ORES

Ore	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
				Percent		
Feed—Acid-sol Fe	29.4	31.6	41.1	16.9	39.1	43.6
Feed—Magnetic Fe	27.5	24.4	36.8	14.0	26.9	40.1
Coarse Conc—Acid-sol Fe	—	—	—	70.0	69.2	67.6
Fine Conc—Acid-sol Fe	64.7	60.0	56.0	66.5	71.2	66.1
TOTAL CONC—ACID-SOL FE	64.7	60.0	56.0	68.9	69.5	67.3
Coarse Tails—Acid-sol Fe	5.5	13.9	12.0	3.4	22.5	15.1
Fine Tails—Acid-sol Fe	7.4	13.9	29.3	4.0	17.2	10.2
RECOVERY MAGNETIC FE	89.5	90.7	67.1	95.0	95.5	92.5
CONCENTRATION RATIO	2.6	2.7	2.3	5.3	2.7	1.8
				Percent		
Dust Loss, Wt	4.7	5.7	8.5	2.3	3.2	1.9
Dust Loss of Acid-sol Fe	2.4	4.5	7.3	1.8	0.6	1.2
Dust Loss of Magnetic Fe	1.9	3.0	6.8	0.7	0.3	0.7

a single layer of particles on the drum. In the case of material finer than 150 mesh, the particles are presented to the magnetic field as an airborne dust to prevent the formation of magnetite agglomerates which might entrain particles of silica.

The **Fast Eccentric Drum separator** (see lower schematic diagram adjoining figure 2) was designed for treatment of particles from minus eight to +150 mesh. For certain ores, two of these drums were used, mounted one below the other. An arrangement of baffles can be set so that either the concentrate or the tailings from the top drum can be retreated on the lower drum. In other cases, a third drum was added to the circuit for the purpose of retreating the concentrate produced by the first two.

Each magnet drum and stainless steel drum is driven by a ½-hp, 110-volt dc motor equipped with a variable field resistance for control of speed.

The **Double Helix separator,** designed to make a finished concentrate containing 30 to 40 percent −325 mesh from −150 mesh feed, is essentially the same as is shown in the schematic diagram adjoining figure 3, consisting of a batch of four drums. The top two drums operate in parallel, with the lower drums retreating the tailings from those above.

The drums on the Double Helix are driven in pairs. A one-hp, 550-volt ac motor drives the top two magnet drums, and a similar motor drives the top two stainless steel drums. The bottom two magnet drums are driven by a ½-hp, 550-volt ac motor, as are the bottom two stainless steel drums. Each motor is equipped with a variable speed reduction gear.

TABLE II
DRY MAGNETIC SEPARATION OF MIXED MAGNETITE–HEMATITE ORE

(a) Primary Magnetic Concentration

Product	Wt %	Analysis % Acid-Sol Fe	Analysis % Magnetic Fe	Distribution % Acid-Sol Fe	Distribution % Magnetic Fe
Feed	100.0	39.1	26.9	100.0	100.0
Coarse concentrate	31.5	69.2	69.2	55.7	80.9
Fine concentrate	5.5	71.2	71.2	10.0	14.5
Coarse tailing	46.4	22.5	1.6	26.9	2.8
Fine tailing	13.4	17.2	2.6	5.9	1.3
Dust	3.1	19.3	3.0	0.6	0.5

(b) Overall Results
(including concentration of roasted tailing from primary magnetic concentration)

Product	Wt %	Analysis % Acid-Sol Fe	Distribution % Acid-Sol Fe
Feed	100.0	37.6	100.0
Primary coarse magnetic conc.	31.5	69.2	57.9
Secondary coarse magnetic conc.	9.2	68.8	16.8
Primary fine magnetic conc.	5.5	71.2	10.4
Secondary fine magnetic conc.	1.7	65.3	3.0
Coarse tailing	37.2	7.4	7.4
Fine tailing	11.8	9.4	3.0
Dust	3.1	19.3	1.5

TABLE III
SCREEN ANALYSIS ON DRUM FEED AND PRODUCTS

Mesh	Feed %*	Concentrate %	Middling %	Tailing %
28	21.1	10.3	8.5	8.5
48	21.7	20.0	19.6	19.6
100	22.7	27.1	27.3	27.3
150	9.2	13.0	12.0	12.0
200	9.3	11.5	12.0	12.0
−200	16.0	18.1	20.6	20.6

* The drum feed was 100% −14 mesh

Feed Rate 1025 lb per hr

Products		Total	Rate
	Concentrate	1910 lb	475 lb per hr
	Tailing	1405 lb	310 lb per hr

Drum Speeds

Top drum	260 rpm	Bottom drum	190 rpm
Top magnets	235 rpm	Bottom magnets	175 rpm

Analysis of Drum Products	Acid-Sol Fe %
Feed	44.3
Concentrate	62.5
Tailing	17.8
Middling	43.8

No Grinding	Weight lb	Weight %	Davis Tube % Conc	Davis Tube Acid-Sol Fe	Magnetic Iron %	Magnetic Iron Units	Magnetic Iron Distn
Feed	1025 lb per hr	100	80.0	51.1	40.8	40.8	100.0
Concentrate	1910	57.7	97.7	62.7	61.2	35.4	86.8
Tails	1405	42.3	47.7	25.7	12.3	5.4	13.2

Ground to −100 mesh	Weight lb	Weight %	Davis Tube % Conc	Davis Tube Acid-Sol Fe	Magnetic Iron %	Magnetic Iron Units	Magnetic Iron Distn
Feed		100.0	62.3	63.4	39.5	39.5	100.0
Concentrate	1910	57.7	89.0	67.5	60.2	34.9	88.5
Tails	1405	42.3	30.0	38.8	11.7	4.5	11.5

In this particular run, the concentrate ran about 62 to 63 percent acid soluble iron with a recovery of approximately 87 percent of the magnetic iron in the concentrate. For determining the recovery figures, the middlings were disregarded because they were recycled to the mill.

It should also be noted that the top drum was fed along only four in. of the drum surface.

Test Results

Satisfactory test results can normally be obtained for a reasonably long run after treating somewhere between 50 and 100 tons in this pilot plant. A 50-ton sample is about the minimum from which reliable and optimum results can reasonably be expected to be obtained.

Table I shows selected results obtained on some of the ores tested. The first three samples are fine grained ores, and the last three are coarse grained. These are examples of test runs, and are only a portion of the results obtained on the ores because, during the test of each ore, conditions are varied to attempt to reach an optimum result.

Table II shows the results that could be expected from a flowsheet based on the results of tests on a mixed magnetite-hematite ore. In these tests, the non-magnetic dry tailings from dry magnetic separation of the magnetite was given a magnetizing roast, and then concentrated by dry magnetic separators.

The basic difference between dry and wet magnetic separation is that the objective in wet separation is only to pick up from a viscous medium those particles containing a worthwhile percentage of magnetic iron. The objective in dry magnetic separation is to lay all of the finely ground ore on the magnetic separator drum, and then to throw off those particles which are not wanted. In order to do this the layer of ore on the drum should approach single particle depth, and therefore the separator drums must travel at high speed to get reasonable capacity. Centrifugal force overcomes the magnetic field and throws off gangue particles. This action is highly selective and, in some cases, can be adjusted (by changing

TABLE IV
STRINGER LENGTH (In.)

Mesh	68 hertz	80 hertz	100 hertz	120 hertz	140 hertz
100	0.0516	0.0444	0.0354	0.0330	0.0264
150	0.0540	0.0474	0.0390	0.0330	0.0306
200	0.0606	0.0516	0.0414	0.0348	0.0312
270	0.0624	0.0516	0.0432	0.0378	0.0330
325	0.0564	0.0474	0.0384	0.0318	0.0288

from the relative particle speed between the drum and magnet speeds or the gap between the drum and magnets) to throw away particles containing very finely disseminated magnetite. In some cases, such particles would be picked up by the wet magnetic separators, and would lower the grade of the concentrate. An example of this type of selection of a high grade concentrate and rejection of a tailing containing finely disseminated magnetite is shown in table III.

Fine magnetite particles on the surface of the stainless steel separator drums travel in stringers rather than as single particles. Figure 6 shows the results of measurements of particle speed on the drum surface for different particle sizes and for different frequencies of alternation of the magnetic field. The frequency of the magnetic field measured in cycles per second, or hertz, is increased by increasing the difference in speed between the outer stainless steel drum and the magnets. This figure shows that particle speed increases with decreasing particle size down to about 50 microns: below this size it decreases sharply. If it is assumed that (1) there is no slippage between particles in the outer shell; (2) that particle movement is due only to an end over end motion, and (3) that particles travel in stringers: then, the stringer length may be calculated cause the distance travelled per second per hertz will be twice the length of the stringer.

Thus from table IV it may be seen that the length of the stringers increases with decreasing feed particle size down to 50 microns, and then decreases—thus explaining the effect of feed particle size on particle speed. By correlating stringer length and particle size it appears that at 68 hertz, 100-mesh material forms a stringer approximately nine times the length of the particle; and that 325-mesh material forms a stringer approximately 33 times the length of the particle. This indicates that less tailing entrapment is likely to occur at coarser feed sizes, and separation is likely to be more efficient, which is to be expected.

Similarly, by increasing field frequency from 68 to 140 hertz, stringer length for any one size fraction is approximately halved, so that better separation should occur at higher frequencies which again is as to be expected.

Further study of the commercial flowsheets and estimates of plant costs and operating costs are going forward.

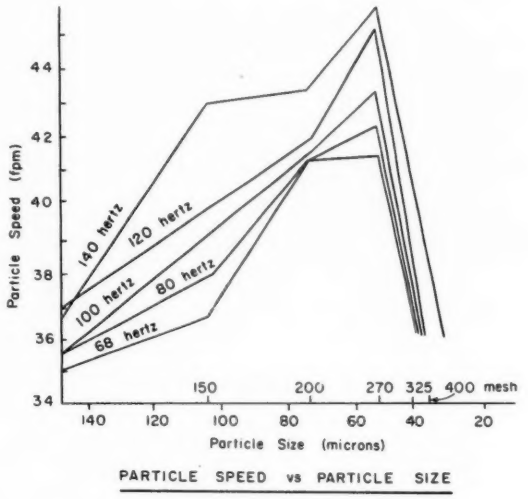

Fig. 6. Particle speed on separator drum surface versus particle size for different frequencies of magnetic field alternation measured in hertz (cycles per sec)

DIVIDENDS FROM MAINTENANCE

(Continued from page 52)

graduates and graduates of trade schools. The company is fortunate that a good percentage of the boys graduating from the local high school go on to trade school. The coal concern always has a large number of applications for repair and maintenance jobs. One of the most important preventive maintenance measures is to have skilled operators for the machinery and well-trained mechanics with real ability to repair and rebuild machinery. Practically all of Elk River's maintenance men are taken from its own labor force and trained for the job in its shops.

Men applying for the training program are interviewed, selected, and get their experience by helping rebuild machines in the main shop under the supervision of an experienced mechanic. The trainee begins by helping the mechanic dismantle whatever piece of machinery is on the floor at the moment. When it is completely dismantled, he is told to check each part to determine its condition and is told what to look for. He is constantly supervised by lead men and foremen experienced in the work. When every piece has been cleaned and inspected, the rebuilding starts. In this part of the job, the apprentice is at first only to observe and ask questions. He is an observer on two jobs, and then is permitted to assist with the rebuilding under the observation of the shop foreman. Job after job is given the beginner, until the company is sure he is a capable repairman, or has determined that he is not a real mechanic. If he shows interest and capability, he is kept in the rebuilding shop for 18 months or until he is ready for work on an inside section.

Summary

This article has dealt particularly with how Elk River Coal & Lumber has solved some of its maintenance problems, by mentioning some changes on different machinery and maintenance methods in regard to substations, motors, and armatures. The company's rebuilding and training programs have also been described.

To sum up this paper on preventive maintenance, here are a few simple rules to keep in mind that are not new to anyone in charge of maintenance but are very effective in preventing breakdowns:

1. **Make frequent, complete, thorough inspections at regular intervals.**
2. **Properly lubricate equipment.**
3. **Make repairs before machine fails and permanently damages the equipment.**
4. **Have machines operated only by skilled operators and maintained only by thoroughly trained mechanics and electricians.**

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Program Set for

1959

Coal Show

COAL will reign as King in Cleveland May 11-14, as thousands of mining men from all over the world converge for the 1959 Coal Show of the American Mining Congress. Focal point of activity will be Cleveland's huge Public Auditorium where both a giant machinery Exposition and the all inclusive technical sessions will be held.

The National Program Committee, under the chairmanship of E. P. Humphrey, Stonega Coke & Coal Co., has gone all-out to provide a program in line with today's modern, mechanized coal industry. Even a cursory examination of the Advance Program, printed on the following pages, will reveal the wide range of important subjects to be discussed. Convention sessions, with their authoritative presentations and informal discussions, will explore the latest advances in deep and strip mining as well as coal preparation and the problems of management and safety. Of particular interest to metal mining men and industrial minerals producers will be a special session devoted to cost cutting in open pit mining.

The Exposition will fill the Public Auditorium's vast exhibit halls and overflow into a large outside area. More than 235 manufacturers of mining equipment, supplies and machinery for use in the Nation's mines will be represented by exhibits. These displays will effectively portray the latest advances in safety and efficiency, and will be staffed by specialists prepared to demonstrate equipment, answer questions and discuss individual problems.

A look at the list of exhibitors on pages 70 and 71 will show that all the major suppliers to the mining industry will be on hand. Convention sessions will not be held Monday afternoon,

(*Top of Next Page*)

MONDAY—MAY 11

10:00 A.M.—CONTINUOUS MINING

Chairman—Jesse F. Core,
Vice President, Coal Division, U. S. Steel Corp.

Developments in Face Ventilation and Dust Control

Experience with various methods of establishing good face ventilation in continuous mining machine sections, including application of line brattice, auxiliary fans, blower and fan installation and a dust collector-ventilating fan combination will be discussed.

John B. Kebbish, General Superintendent,
Mountaineer Coal Co., Fairmont, W. Va.

Advances in Roof Control

Based upon a survey of mine operators, here is a round up of the most recent developments in controlling mine roof on continuous mining sections.

James T. Jones, Assistant Superintendent,
Mather Collieries, Mather, Pa.

Coal Transportation From Continuous Mining Equipment

A representative of a large mining company operating in Pennsylvania, West Virginia and Kentucky with production of approximately 50 percent from several types of continuous mining machines in many different coal seams and mining conditions will analyze experience with the different face haulage systems tried to date.

Bruce E. Duke, Assistant to the Manager,
Bethlehem Mines Corp., Johnstown, Pa.

TUESDAY—MAY 12

10:00 A.M.—UNDERGROUND POWER

Chairman—R. G. Heers,
Manager of Mining & Raw Materials, Kaiser Steel Corp.

Are A-C Sections in D-C Mines Practical

Two speakers will analyze whether or not a company can realize economic benefits by installing a-c sections in established d-c properties

James Wiley, Electrical Engineer,
Rochester & Pittsburgh Coal Co., Indiana, Pa.

Discussion: Joseph Albasin, Mechanical & Electrical Engineer,
Youghiogheny & Ohio Coal Co., Martins Ferry, Ohio

Why we Decided to Open a New Mine with A-C Power

Ayrshire Collieries is opening a 1,500,000-ton per year mine at Terre Haute. Ind., using 440 volt a-c face equipment and a-c powered conveyors for mainline haulage.

L. E. Briscoe, Electrical Engineer,
Ayrshire Collieries Corp., Indianapolis, Ind.

Experience with High Voltage Distribution Systems Underground

Drawing upon experience gained with 90,000 ft of high voltage distribution cable underground, the speaker will describe different methods of cable preparation, ways of installation, and will discuss failures that have occured as well as outlining means to prevent these failures.

John W. Looney, Electrical Engineer,
Pocahontas Fuel Co., Pocahontas, Va.

Advantages of Higher Utilization Voltages Underground

With face equipment getting larger and larger, the time is coming when it will be advisable to raise the present restrictions on utilization voltages in underground coal mining.

Representative of American Mining Congress
Committee on Underground Power

May 11, or Wednesday morning, May 13, thus affording mining men added time to inspect and compare the many types of equipment designed to aid the industry in doing a better job.

As in the past, metal mining men and industrial minerals producers will also find the Coal Show of great value. Most of the equipment on display has direct application to their problems as well as to coal's, and the convention papers will contain much information that they can utilize.

Plans are also being made to assure a full schedule of entertainment for mining men and their wives. The traditional Coal Miners Party will be held on Wednesday evening, featuring a superb dinner, dancing and a lively floor show. Always the talk of the Show, the Coal Miners Party is an event that no one will want to miss.

No formal entertainment is scheduled for Monday, Tuesday or Thursday evenings. These have been left open for visiting and attending special parties, so much a part of the fun and good fellowship of Coal Show week.

Ladies are cordially invited to attend the Coal Show and all its activities. They will also want to take full advantage of Cleveland's many interesting sights and fine shops. In addition two special events have been arranged for them. A fashion luncheon will be held Monday at Halle Bros. department store. Tuesday, following a luncheon at Westwood Country Club, there will be a unique demonstration of floral arrangements by Mrs. Herbert H. Greger, author, columnist and internationally known floral designer.

Interest in the Coal Show is high and advance registration indicates that Cleveland's hotel accommodations will be taxed to the limit. All mining men interested in attending the Coal Show—if they haven't already done so—are urged to send in their applications for accommodations as quickly as possible. Requests should be addressed to the Cleveland Hotel Reservation Bureau, 511 Terminal Tower, Cleveland, Ohio (Telephone: Main 1-4110).

The AMC Convention and Exposition offers an exceptional opportunity. Nowhere else is it possible to talk to so many industry leaders, learn so much about new mining methods and techniques, and see the largest display of mining equipment in the world. So don't delay, make arrangements NOW to attend the 1959 Coal Show.

Tuesday, May 12 *(Cont.)*

10:00 A.M.—STRIP MINING

Chairman—Arnold Lamm,
President, Sunnyhill Coal Co.

Multiple Seam Stripping

Pittsburg & Midway is stripping three seams concurrently in western Kentucky.

O. E. May, Manager, Paradise Mine,
Pittsburg & Midway Coal Mining Co., Drakesboro, Ky.

Recent Applications of Wire Line Coring Techniques in Coal Exploration

A new technique for pulling cores promises to improve core recovery and reduce coal exploration costs in the same way that it has in other branches of the mineral industry.

M. J. Gleason, Manager, Contract Drilling Division,
E. J. Longyear Co., Minneapolis, Minn.

Highway Augering

Introduction of the twin auger has had its impact on highwall mining. A representative of a contract mining company will tell what this new machine has meant to them.

John R. Karnap, General Manager,
Elm Development Co., Oak Hill, Va.

Use of Continuous Mining Equipment in Highwalls

"Punch mining" with an auger-type continuous mining machine at Harcliff Mining Co. in East Brady, Pa., has permitted the economical recovery of coal that ordinarily would be left behind.

J. C. Forrest, Jr., President,
Harcliff Coal Co., Oliver Building, Pittsburgh, Pa.

Remote Control Highwall Mining

Recent developments in the art of mining coal with remotely controlled continuous mining equipment will be examined.

John W. Heimaster, Bore Mining Department,
Union Carbide Chemicals Co., South Charleston, W. Va.

2:00 P.M.—SAFETY

Chairman—Marling J. Ankeny,
Director, U. S. Bureau of Mines

A Continuous Methane Monitoring System at the Working Face

Concerted effort by several industries promises a major breakthrough in the development of a system whereby equipment working in the face will be shut down when the methane content of mine air builds up to a dangerous concentration.

Robert S. James, Chief, Branch of Electrical-Mechanical Testing, U. S. Bureau of Mines, Pittsburgh, Pa.

Mine Fire Fighting in the Pittsburgh Seam In Northern West Virginia

Experience with mine fires in the Pittsburgh seam in northern West Virginia will be described and preventive measures outlined.

William O. Barnard, Jr., General Superintendent,
Christopher Coal Co., Osage, W. Va.

Fire Resistant Hydraulic Fluids for Coal Mines

As the result of a cooperative development program spearheaded by the Bureau of Mines, a fire-resistant hydraulic fluid is now available for coal mine applications. With the use of this type fluid, safety in mines will be greatly improved.

A. S. Morrow, Senior Engineer—Industrial, Products Application Department, Shell Oil Co., New York, N. Y.

Safety Problems Involved in Strip Mining

Adverse weather creates hazardous conditions in strip mining that are extremely difficult to overcome. Personnel trained in the art and skill of stripping coal in all kinds of weather are of vital importance to the prevention of accidents.

E. E. Quenon, Director of Safety,
Peabody Coal Co., St. Louis, Mo.

Much Can be Done to Improve Coal Mine Safety

Coal mine safety today is an engineering project and must be given the same emphasis that is accorded mine projection and equipment selection. Safety is also a cooperative sales engineering job—a job that demands the same sincerity by all department heads that is given any mining phase.

Dennis J. Keenan, Vice President,
Sterling Coal Co., Bakerton, Pa.

(Continued on next page)

Advance Program

(Continued from previous page)

TUESDAY—MAY 12
SPECIAL SESSION

2:00 P.M.—COST CUTTING IN OPEN PIT MINING—INDUSTRIAL MINERALS

Chairman—L. J. Patterson,
Manager, Northern District,
Michigan Limestone Division, U. S. Steel Corp.

Blasting Wet Holes with Ammonium Nitrate

This low cost blasting agent, although well established at many mining operations, has not universally proved itself for use in wet holes. Many companies are experimenting with wet-hole applications and attaining varying degrees of success. Three operators from different areas will tell about their efforts to use ammonium nitrate under difficult conditions.

Mark F. Withey, Jr., Blasting Engineer,
Material Service Corp., Lyons, Ill.

Robert W. Bell, Superintendent,
Erie Mining Co., Hoyt Lake, Minn.

Frank Coulson, Mine Manager,
Central Ohio Coal Co., Zanesville, Ohio

Determination of Overburden Composition By Simple Seismographic Methods

Extensive tests of a simple, portable seismograph have shown that its use can help to locate and identify—with extreme accuracy—the various strata below the working surface. By using a minimum of reference data, such as that obtained from old drill holes, exposed banks or local geologic studies, seismographic readings quickly reveal information about the sub-surface formations that will enable engineers to select the most efficient methods and equipment, with advance knowledge of the thicknesses to be removed.

C. R. Fahnestock, Application Engineer,
Caterpillar Tractor Co., Peoria, Ill.

New Steels to Cut Operating Costs

American steel producers have made new high-quality materials available for users of both large and small mining equipment. The advantages of using these special products in repair work, in redesign of equipment and in general maintenance are far-reaching in their economic potential.

Dan J. Snyder, Alloy Service Dept.,
U. S. Steel Corp., Pittsburgh, Pa.

Economics of Various Types of Quarry Haulage

Trucks, conveyors, scrapers, skips and rail haulage systems all have their place in quarry work. The discussion will cover the important factors that must be weighed to determine which will provide the lowest cost transportation for any particular operation.

Orrin D. Weeks, Technical Assistant to Plant Manager,
Calaveras Cement Co., San Francisco, Calif.

Cost Reduction in Quarrying Through Automation

Instrumentation and electrical controls are finding ever increasing applications in the mineral industries. To reduce costs, it is important that quarry and mine operators learn about the automation devices that may have applications on their jobs.

E. V. McClure, District Manager,
Western Knapp Engineering Co., Chicago, Ill.

WEDNESDAY—MAY 13

2:00 P.M.—COAL PREPARATION

Chairman—Richard F. Wesner,
Vice President and General Manager,
Boone County Coal Corp.

Centrifuging Stoker Coal

Joanne Coal Co. is dewatering stoker coal in centrifugal dryers to the point that it can be shipped without further drying.

E. A. Watters, Jr., Chief Engineer,
Joanne Coal Co., Pittsburgh, Pa.

Heavy Medium Cyclones

A description will be given of a typical, modern heavy medium cyclone washery. Results obtained at several European preparation plants will be examined and the possible application of this equipment in the United States will be analyzed.

Dr. C. Krijgsman, Head, Coal Preparation Division,
Staatsminjen, Trabeck, The Netherlands

Froth Flotation—A Tool for Increased Profits

There are economic reasons behind the growing trend in froth flotation of coal. These include: a market demand for better quality, the necessity of increasing the yield of marketable coal, and the movement toward the cleaning of minus 28 mesh coal.

W. L. McMorris, Jr., Director, Coal Preparation and Distribution,
U. S. Steel Corp., Pittsburgh, Pa.

Electrical Side of Preparation Plant Design

In laying out coal cleaning plants, the preparation engineer has a wide choice of electrical equipment to choose from. The range of selection will be discussed as will criteria that can be followed in making a final decision.

D. E. Hamilton, Application Engineer, Indusrial Engineering Section,
General Electric Co., Schenectady, N. Y.

Dust Collection in Coal Preparation Plants

The impact of air pollution control is of growing concern to the coal industry as preparation plants get larger and thermal drying increases in favor. The author discusses dust collection equipment now available and outlines results that can be expected under various conditions.

Henry F. Hebley, Consulting Engineer,
Pittsburgh, Pa.

2:00 P.M.—MANAGEMENT & COST CONTROLS

Chairman—E. M. Pace,
General Superintendent, Inland Steel Co.

Positive Application of Industrial Engineering To Coal Mining

Industrial engineering has gone beyond the time study stage in the coal industry. A positive approach to the use of this important production tool will result in increased efficiency and reduced costs.

L. J. Prelaz, Senior Associate, Coal Standards, Inc.,
Mammoth. W. Va.

Using IBM Methods to Reduce Supply Costs

Pocahontas Fuel Co. has found that supply cost control can be improved through the use of IBM machines.

E. P. Bucklen, Special Engineer,
Pocahantas Fuel Co., Pocahantas, Va.

An Industrial Engineer Looks at Cost Control

To lead its competition, a coal company must have an active program of directing costs downward. Success de-

pends on effective team work involving first-line foremen. The industrial engineer's greatest contribution is his ability to bring the factors of industry—men, machines and material—together for profitable production.

Earl L. Peterson, Chief Industrial Engineer,
Paul Weir Co., Chicago, Ill.

Selection of Supervisors

Good supervision is the primary defense of any coal producer in the constant battle against rising costs. The selection of proper supervisors is becoming increasingly important to efficiency-minded operators.

H. M. Tibbs, Administrative Assistant,
Truax-Traer Coal Co., Kayford, W. Va.

Training Programs for Operators of New Equipment

Based upon experience, the training staffs of TCI's Coal and Ore mines describe an approach to the problem of training personnel in the operation of newly installed equipment.

Walter H. Fleming, Supervisor of Training, Coal Mines,
Tennessee Coal & Iron Division,
U. S. Steel Corp., Fairfield, Ala.

THURSDAY—MAY 14

10:00 A.M.—EQUIPMENT MAINTENANCE

Chairman—R. W. Fox,
Vice President, Production,
The North American Coal Corp.

Training Maintenance Personnel

Careful selection of personnel, thorough class instruction in basic electricity, practice in welding and burning, and intensive shop training have been an important part in Duquesne Lights' program to assure a supply of competent maintenance men.

A. R. Hood, Superintendent, Warwick Mine,
Duquense Light Co., Greensboro, Pa.

Discussion: C. B. Fulmer, Superintendent, P. & M. Dept.,
Stonega Coke & Coal Co., Big Stone Gap, Va.

Continuous Mining Equipment Maintenance

The effectiveness of continuous mining equipment depends on good maintenance. The author will fully develop his company's program of mechanical, electrical and hydraulic maintenance to get the most out of the eight continuous mining machines it operates at this time.

Wm. Laird, Mine Superintendent, Eastern Gas & Fuel Associates,
Grant Town, W. Va.

Preventive Maintenance

Princess Elkhorn has developed an effective preventive maintenance program. Four years were spent in training and preparing the maintenance personnel, before setting up a unit change-out system of preventive maintenance. Many on shift breakdowns are prevented. In use three years the system has proved its effectiveness.

Walter M. Crace, Superintendent of Power & Maintenance,
Princess Coals, Inc., Huntington, W. Va.

Overhauling Mining Equipment

Should a company overhaul its own equipment or should it utilize the services of outside specialists? Berwind-White has thoroughly analyzed this question and the authors will report their findings.

W. R. Wood, Electrical Superintendent, and
P. C. Stull, Supervisor of Maintenance,
The Berwind-White Coal Mining Co., Windber, Pa.

10:00 A.M.—STRIP MINING

Chairman—W. J. Crawford,
Vice President, The Enos Coal Mining Co.

Economic Aspect of Large Stripping Equipment

The development of larger stripping units has had great impact on the coal mining industry. Two speakers will discuss how recent developments in design have influenced the choice of equipment. One result is that smaller and older stripping units are rapidly becoming obsolete.

Shovels: J. P. McDowell, Superintendent, River King Mine,
Peabody Coal Co., Freeburg, Ill.

Draglines: Lafe Stewart, Chief Engineer,
Maumee Collieries Co., Terre Haute, Ind.

Machine Loading Blast Holes with Ammonium Nitrate

There are many instances when machine loading of blast holes offers different advantages. Some of these are outlined by the author who has had some unusual experiences with blast hole loading.

D. S. Blount, President,
Raleigh Eagle Coal Co., Ameagle, W. Va.

Power Distribution in Strip Mines at 7200 Volts

Handling 7200 volts in strip mines poses special problems. Factors such as design, operation, maintenance and economics will be covered, with emphasis being placed on safety.

Robert V. Bovenizer, Electrical Engineer,
Hanna Coal Co., Cadiz, Ohio

Future Trends in Strip Mine Haulage Equipment

Both truck manufacturers and truck users have been surveyed to learn what are the expected advances in truck design in the next five to ten years. One conclusion—bigger units appear to be on the way.

T. G. Gerow, Consulting Mining Engineer,
Minneapolis, Minn.

2:00 P.M.—THIN SEAM MINING

Chairman—J. L. McQuade,
President, Donegan Coal & Coke Co.

Continuous Mining in Thin Seams

Crichton Coal and Coke Co. is using a system of face haulage which involves an extensible belt conveyor having sufficient side reach to allow the driving of multiple entries from one heading.

Andrew B. Crichton, Jr., President
Crichton Coal & Coke Co., Johnstown, Pa.

Conventional Mining in Thin Seams

Thin seam mining imposes many problems not encountered in thicker seams. Osborne Mining Corp. has improved efficiency by increasing the tonnage prepared per working place, installing large capacity elevators at loading points, altering mine projections and establishing a definite pattern for the movement of equipment at the face.

James Carter, Superintendent,
Osborne Mining Corp., Williamson, W. Va.

Roof Control in Thin Seams

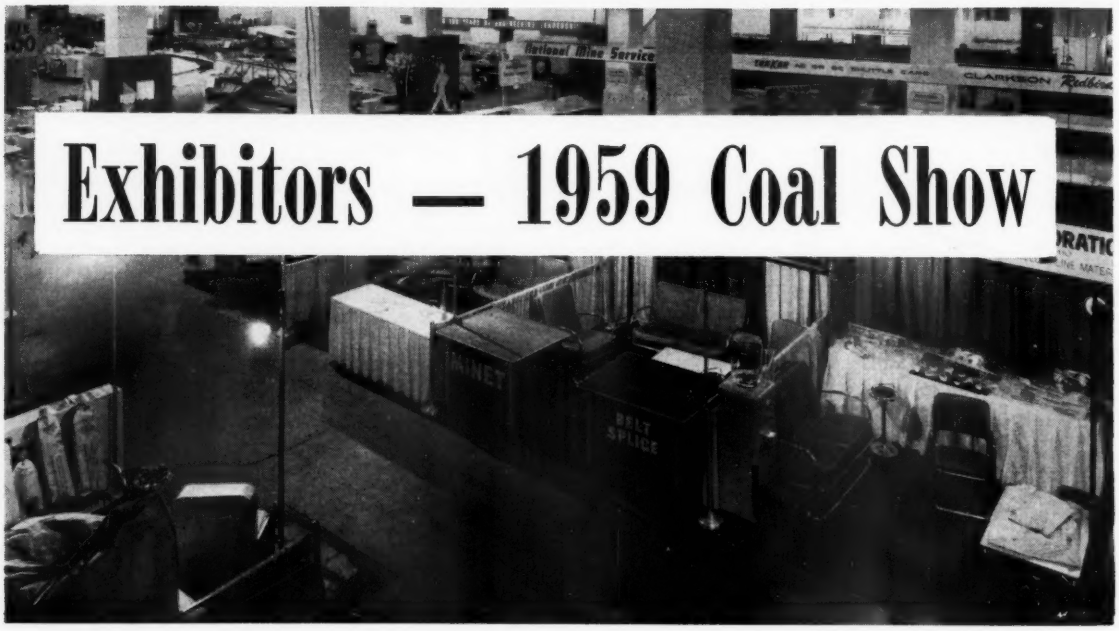
Bad top is being held in rooms up to 55 ft wide in a 34-in. seam by using an extra long bolt in conjunction with a conventional bolting plan.

Stonie Barker, Mine Superintendent,
Island Creek Coal Co., Wyoming, W. Va.

Underground Augering Under Difficult Seam Conditions

The author will describe the application of a coal auger in an underground coal mine in eastern Tennessee.

Tom N. Shattuck, Mine Superintendent,
Wind Rock Coal & Coke Co., Oliver Springs, Tenn.



Exhibitors — 1959 Coal Show

A

Acme Machinery Co.
Aeroquip Corp.
Airdox-Cardox Products Co.
Allegheny Ludlum Steel Corp.
Allis-Chalmers Mfg. Co.
American Air Filter Co., Inc.
American Brattice Cloth Corp.
American Bridge Division
United States Steel Corp.
American Car & Foundry Division
of ACF Industries, Inc.
American Cable & Hazard Wire
Rope Divs., American Chain &
Cable Co., Inc.
American Cyanamid Co.
Explosives & Mining Chemicals
Department
American Mine Door Co.
American Steel & Wire Division
United States Steel Corp.
Anaconda Wire & Cable Co.
Arcair Company
Armco Drainage & Metal
Products, Inc.
Ashland Oil & Refining Co.
Atlas Powder Co.
Austin Powder Co.

B

Baldwin-Lima-Hamilton Corp.
Construction Equipment Div.
Barber-Greene Co.
Barrett Haentjens & Co.
Bearing Service Co.
Bemis Bro. Bag Co.
Bethlehem Steel Co.
Bird Machine Co.
Bixby-Zimmer Engineering Co.
Boston Woven Hose & Rubber Co.
Div. of American Biltrite
Rubber Co.
Bowdil Company
Broderick & Bascom Rope Co.
Bucyrus-Erie Co.
Burndy Corporation
Buttner Works, Inc.

C

Caterpillar Tractor Co.
Central Mine Equipment Co.
Centrifugal & Mechanical
Industries, Inc.
Chicago Pneumatic Tool Co.
Cincinnati Mine Machinery Co.
Cities Service Oil Co.
Clark Equipment Co.
Coal Age
Colorado Fuel & Iron Corp.
Columbus McKinnon Chain Corp.
Combustion Engineering, Inc.
Raymond Division
Commercial Testing & Engineering
Company
Compton, Inc.
Connellsville Mfg. & Mine Supply
Company
Connors Steel Div., West Virginia
Works, H. K. Porter Co., Inc.
Continental Motors Corp.
Conveyor Belt Service, Inc.
Cooke-Wilson Electric Supply Co.
Cross Perforated Metals Plant
Div. of National-Standard Co.
Cummins Engine Co., Inc.

D

Davey Compressor Co.
Rotary Drill Division
Deister Concentrator Co.
Denver Equipment Co.
Denison Engineering Division
American Brake Shoe Co.
Derrick Mfg. Co.
Detroit Diesel Engine Division
General Motors Corp.
Diamond Iron Works
Division Goodman Mfg. Co.
Differential Steel Car Co.
Dodge Mfg. Corp.
Dorr-Oliver Incorporated
Dowty Mining Equiment Limited
Du Pont de Nemours & Co.,
Inc. E. I.

E

Eimco Corporation
Electric Steel Foundry Co.
Elliott Service Co., Inc.
Ensign Electric & Mfg. Co.
Enterprise Wheel & Car Corp.
Euclid Division
General Motors Corp.
Exide Industrial Division
Electric Storage Battery Co.

F

Fairmont Machinery Co.
Fairview Bit Co.
Federal Mogul Service
Femco, Inc.
Firth Sterling, Inc.
Fletcher & Co., J. H.
Flexible Steel Lacing Co.
Flood City Brass & Electric Co.
Freds Welding Service
Fuel Process Co.
Fuller Mfg. Co.

G

Galis Electric & Machine Co.
General Cable Corp.
General Electric Co.
General Equipment & Mfg. Co.
General Splice Corp.
Geodimeter Co.
Division of Berg, Hedstrom &
Co., Inc.
Goodman Mfg. Co.
Goodrich Industrial Products
Co., B. F.

Goodyear Tire & Rubber Co.
Gorman-Rupp Co.
Gould-National Batteries Inc.
Goyne Pump Co.
Gulf Oil Corp.
Gundlach Machine Co., T. J.
Div. of J. M. J. Industries, Inc.

H

Hamilton Rubber Mfg. Corp.
Hammermills, Inc.
Harnischfeger Corp.
Heintz Mfg. Co.
Heli-Coil Corp.
Hendrick Mfg. Co.
Hendrix Mfg. Co.
Hercules Powder Co.
Hewitt-Robins
Hewson Co., Inc.
Heyl & Patterson, Inc.
Hose Accessories Co.
Hoyt Wire Cloth Co.

I

Industrial Nucleonics Corp.
International Harvester Co.
Interstate Equipment Corp.
Irwin-Sensenich Corp.

J

Jeffrey Mfg. Co.
Jones & Laughlin Steel Corp.
Joy Mfg. Co.

K

KW-Dart Truck Co.
Kaiser Aluminum & Chemical Corporation
Kanawha Mfg. Co.
Keenan Oil Co.
Kelly Mfg. Co.
Kennametal Inc.
Kensington Steel
Division of Poor & Co.
Koehring Division
Koehring Company

L

L & M Radiator Service, Inc.
Laboratory Equipment Corp.
Lecco Machinery & Engineering Company
Lee-Norse Co.
Le Roi Division
Westinghouse Air Brake Co.
Leschen Wire Rope Division
H. K. Porter Co., Inc.
LeTourneau, Inc., R. G.
LeTourneau-Westinghouse Co.
Lincoln Engineering Co.
Link-Belt Co.
Long Company
Longyear Co., E. J.
Ludlow-Saylor Wire Cloth Co.
Lukens Steel Co.

M

McKay Company
McLanahan & Stone Corp.
McLaughlin Mfg. Co., Inc.
McNally-Pittsburg Mfg. Corp.
Mack Trucks, Inc.
Macwhyte Wire Rope Co.
Mancha Storage Battery
Locomotive, Division Goodman Mfg. Co.
Manitowoc Engineering Corp.
Marion Power Shovel Co.
A Division of Universal Marion Corporation
Martindale Electric Co.
Martin Engineering Co.
Mechanization, Inc.
Megator Pumps & Compressors, Incorporated
Metallurgical Products Dept.
General Electric Co.
Mine Safety Appliances Co.
Mining Congress Journal
Mining Machine Parts, Inc.
Mining Progress, Inc.
Mining & Quarrying
Monsanto Chemical Co.
Motorola Communications & Electronics
Mountain State Equipment Co.
Myers-Whaley Co., Inc.

N

National Electric Coil Co.
National Malleable & Steel Castings Co.
National Mine Service Co.
National Tube Division
United States Steel Corp.
Nolan Company
Nordberg Mfg. Co.
NoVo Division
Industrial Enterprises, Inc.

O

Ohio Brass Co.
Ohio Carbon Co.
Okonite Co.
Explosives Division
Olin Mathieson Chemical Corp.
Oliver Corporation
Osmose Wood Preserving Co. of America

P

PLM Products, Inc.
Pattin Mfg. Co.
Penn Machine Co.
Peterson Filters & Engineering Company
Pittsburgh Screw & Bolt Corp.
Plastic Wire & Cable Corp.
Porter Co., Inc., H. K.
Leschen Wire Rope Division
Thermoid Division
Connors Steel Division,
West Virginia Works
Proto Tool Co.
Div. of Pendleton Tool Industries, Inc.
Prox Co., Inc., Frank
Pure Oil Co.

R

Raybestos-Manhattan, Inc.
Manhattan Rubber Division
Reich Bros. Mfg. Co., Inc.
Reliance Electric & Engineering Company.
Republic Steel Corp.
Roberts & Schaefer Co.
Roebling's Sons Corp., John A.
Rome Cable Corp.
Rust-Oleum Corp.

S

S K F Industries, Inc.
Salem Tool Co.
Sanford-Day Iron Works, Inc.
Schroeder Brothers Corp.
Shell Oil Co.
Simplex Wire & Cable Co.
Sinclair Refining Co.
Socony Mobil Oil Co., Inc.
Spencer Chemical Co.
Stamler Co., W. R.
Standard Oil Co. (Indiana)
Standard Oil Co. (Ohio)
Stearns Magnetic Products
Stratoflex, Inc.
Sun Oil Co.

T

Templeton, Kenly & Co.
Texas Company
Thermoid Division
H. K. Porter Co., Inc.
Timken Roller Bearing Co.
Tool Steel Gear & Pinion Co.
Trabon Engineering Corp.
Tyler Co., The W. S.

U

Union Wire Rope Corp.
Subsidiary of Armco Steel Corp.
U. S. Rubber Co.
Mechanical Goods Division
United States Steel Corp.
United States Steel Supply Div.
United States Steel Corp.
Universal Engineering Corp.

V

Varel Mfg. Co.
Vascoloy-Ramet Corp.
Victaulic Company of America

W

Watt Car & Wheel Co.
Weatherhead Co.
Fort Wayne Division
Wedge Wire Corp.
Wellman Co., S. K.
Werco Steel Co.
Western Machinery Co.
Westinghouse Electric Corp.
Whitmore Mfg. Co.
Whitney Chain Co.
Willys Motors, Inc.
Wire Rope Corporation of America, Inc.

Y

Youngstown Sheet & Tube Co.

Operators' Corner

A New Tool for Blasting

A new explosive agent has been developed by Iron Ore Company of Canada with the aid of Dr. M. A. Cook of the University of Utah. Its unique features include low cost, water compatibility, and greater strength than ammonium nitrate-fuel oil mixtures

By H. E. FARNAM, JR.

Manager of Operations
Iron Ore Company
of Canada

THE Iron Ore Company of Canada has been using ammonium nitrate and fuel oil since 1956. During this period the company has used approximately 11,000,000 lb of this explosive. In 1957, 35 percent of all explosives used were AN-fuel mixtures. Through August of 1958 5,500,000 lb was used, about 75 percent of the total explosive consumption. These figures indicate to what extent the Iron Ore Company has switched to the "do-it-yourself" type of explosive.

During these same eight months of 1958, 7,500,000 yd of rock was moved, some rock quite soft and other rock hard enough to wear out a rotary drill bit with tungsten carbide compact inserts in 500 ft of drilling.

Most users of ammonium nitrate and fuel oil have found that this explosive has some shortcomings, namely, lack of water resistance and the inability to shatter hard rock. With these shortcomings in mind, the Iron Ore Company asked Dr. M. A. Cook, of the University of Utah, to formulate an explosive that would be water resistant and would have the ability to shatter hard rock.

Experiments were started in the latter part of 1956 to accomplish this end. To date a number of interesting explosive compositions have been developed that are water compatible and will shatter hard rock.

Pentolite Booster Improves Detonation

In conjunction with the development of a new series of AN explosives, a primer was designed that is better suited for bulk AN mixtures. Extensive study has determined that the detonation pressure developed by the primer is the most important factor when boostering relatively insensitive high content AN explosives. Referring to the hydrodynamic theory of detonation the explosive pressure of the booster is equal to its density times one-quarter the detonation velocity squared. In other words, explosives of high density and high detonation velocity develop high pressures which make them well suited as AN boosters.

As an example, it can be easily demonstrated that to detonate an unconfined mixture of AN-fuel it requires ten times as much loose grained TNT as it does to do the same job with a block of cast TNT.

The most satisfactory material the company has found for these boosters is 50/50 cast pentolite. This booster is cast to form a cylinder two-in. in diam by two-in. long. The booster weighs about 165 grams (about six oz). The cylinder is cast with two ¼-in. holes for the purpose of allowing 50-grain primacord to be threaded through the middle and tied.

These pentolite boosters have a density of 1.63 and are relatively insensitive. For example, they can be detonated by a No. 6 cap but cannot always be detonated by a single strand of 50-grain primacord taped to the outside of the booster. To insure consistent detonation the two holes are cast in the primer to allow for primacord threading.

The pentolite booster is waterproof and will not deteriorate or crumble when submerged for long periods of time. The cost of the booster is less than 80 cents.

New Explosive Contains Water

The new explosive is a slurried mixture of ammonium nitrate, TNT and water. (Patent applied for.) These slurries can be procured through the explosive manufactures, and can utilize AN in any of its commercial fertilizer forms. Prilled AN requires 20 percent TNT and 15 percent water. The mixture has a density of 1.4. When using a coarse-fine mixture of AN, the water content can be reduced to 14 percent by increasing the TNT content to 21 percent. The density of this mixture is also about 1.4. When using high density AN made either in a graining kettle, tower or by the Stangel process, the water can be reduced to 13 percent and the TNT to 18.5 percent. This slurry mixture will have a density of 1.55. All these mixtures have an unconfined critical diameter of less than six in., and require a minimum booster of 80 grams of tetryl or equivalent.

The usable size range of the TNT for these slurries can vary from four mesh to as fine as 30 mesh, Tyler screen size. There are now TNT pellets on the market that fall within these size ranges. The product best suited for these mixtures is a shot tower TNT with a grain size of minus 10 to plus 14 mesh. Flaked TNT can be used but it requires more water in the mixture to make the slurry. This causes a lower density explosive. Fine grained TNT can be used, but 15 percent more must be added. When using this fine grained TNT the critical diameter and minimum booster is increased considerably.

For comparison let us consider a 94 percent prilled AN and 6 percent fuel oil mixture versus a 65 percent AN, 20 percent TNT and 15 percent water slurry mixture.

Composition	94/6 AN & Fuel Oil	65/20/15 AN, TNT & Water
Density (grams/cc)	0.8	1.4
Critical Diam (inches)	4	4
Min. Booster (grams tetryl)	40	80
Detonation Rate (meters/sec.)	2800	5500
Explosion Press. (kilobars)	18.5	59

If both materials are loaded in the bulk, the slurry will weigh 1.75 times more per foot of borehole. In testing these explosives it was found that both have about the same unconfined critical diameters. However, it requires twice as big a booster to detonate the slurry as it does the AN-fuel. This means the slurry is not

(Continued on page 80)

As Viewed by HARRY L. MOFFETT of the American Mining Congress

WITH well over 6,000 bills introduced, Senate and House Committees have plenty to chew over as they begin consideration of major bills on almost every phase of Federal activity—and, in a number of cases, proposals that the Government enter entirely new fields.

During organization of Committees and Subcommittees, Democrats and Republicans argued on the question of which party is the biggest spender. Republicans charged that Democratic controlled Congresses have appropriated more than the Eisenhower Administration requested, and Democrats replied that Congress cut the President's budgets. It's probable that neither party will win a clear-cut decision.

Meanwhile, liberal members of both parties seem determined to spend more than asked for in the current budget. The Senate is leading the way with passage of two measures—an airport aid bill and an omnibus housing bill—both of which carry many millions of dollars more than requested by the President. The House is expected to take up these measures with little delay.

Although some grass-roots support for economy and a balanced budget is appearing, Congressional offices report that it is far short of the swell which in 1957 caused Congress to cut $5 billion from Federal programs—and Administration spokesmen have already served notice that a budget deficit in the upcoming fiscal year will destroy prospects of tax cuts as well as add billions to the already staggering national debt.

KENNEDY LABOR BILL PUSHED

Moving with unusual celerity, the Senate Labor Subcommittee approved in mid-February a two-part bill by its chairman, Senator Kennedy (Dem., Mass.), dealing with (1) union internal reform and (2) Taft-Hartley Act changes endorsed by labor spokesmen. Prior to its approval, the Subcommittee defeated a move to substitute a stronger bill by Senator Goldwater (Rep., Ariz.) which had the backing of the Administration.

The Kennedy bill is expected to win the prompt approval of the full Labor and Public Welfare Committee and may reach the Senate floor some time in March. It is similar to the Kennedy-Ives bill approved 88-1 last year by the Senate but rejected by the House after its denouncement by both business and labor groups.

In general, the Kennedy bill would require detailed reporting and disclosure of internal affairs of unions, including sources and disbursements of all funds and possible conflicts of interest, establish standards aimed at more democracy in unions, and make it a Federal offense to embezzle union funds, to give or receive bribes, or to destroy or falsify union books and records.

Despite the picketing abuses disclosed by the McClellan "rackets" committee, the Kennedy bill deals with only one limited type of picketing—"shakedown" picketing to extort payments from an employer. Such picketing by a labor organization or its agents would be made an unfair labor practice.

Union-endorsed Taft-Hartley Act changes contained in the Kennedy bill would (1) eliminate the provision which makes striking employes whose jobs have been filled ineligible to vote in union representation elections; (2) authorize prehire contracts in the building and construction industry; (3) require the National Labor Relations Board to assert jurisdiction over all labor disputes arising under the Act, unless it cedes jurisdiction to the States under certain conditions; and (4) redefine the term "supervisor" to place many foremen into unions and bargaining units with the employes they supervise.

On the House side of the Capitol, meanwhile, Chairman Barden (Dem., N. C.) of the House Labor Committee introduced legislation designed to bring about true union reform and announced that his Committee would begin public hearings on reform legislation no later than March 4. Senator McClellan was expected to introduce similar legislation in the Senate despite the Labor Subcommittee's action on the Kennedy bill.

Labor leaders undoubtedly will bitterly denounce provisions of the "tough" Barden-McClellan measures, such as the one barring use of general union funds to influence political elections or legislation, and the outlook for effective labor reform laws remains clouded.

BROADENED TAX BASE URGED

Chairman Mills (Dem., Ark.) of the powerful House Ways and Means Committee declared in a recent speech that the type of tax revision which Congress must undertake is an "intelligent" broadening of the tax base, not a narrowing. Suggesting that such a revision could lead to a lowering of the rates of tax for everyone, he said such action would be the hallmark of constructive tax revision. Elimination of unjustified tax differentials and

Washington Highlights

LABOR: Kennedy bill up for action.
TAX: Broader base sought.
DEPLETION: Measure proposed by Treasury.
STRIP-MINE: Study requested.
UNEMPLOYMENT COMPENSATION: Liberalized benefits proposed.
TVA: Bond measure advocated.
PRICE DISCRIMINATION: Hearings set.
PRE-MERGER NOTIFICATION: Bill approved by Senate subcommittee.
METAL MINE INSPECTION: Measure reintroduced.
MINING SUBCOMMITTEES: Named by House and Senate.
MERCURY: Industry situation reviewed by Justice Department.

preferences, he added, is the basic means to this end.

Mills argued that the tighter the budgetary situation and the more remote the prospects for tax reduction, the stronger becomes the case for revising the tax laws. But, he strongly intimated, there will be no general tax cuts or tax increases this year.

DEPLETION BILL SUBMITTED

By the time this reaches our readers, the House Ways and Means Committee will have held hearings on a bill proposed by the Treasury Department to change the definition of "mining" for percentage depletion purposes. The bill spells out the "treatment processes considered as mining" and also spells out certain treatment processes not considered as mining. The Treasury says its needs this legislation to correct a situation resulting from court decisions which permit certain industries to compute percentage depletion on the basis of the selling prices of the finished product.

Committee Chairman Mills (Dem., Ark.) emphasized before the start of the hearings that they would be limited to the Treasury recommendations, which would seem to prevent attacks in the House on the percentage depletion rates. However, because of the open debate rules of the Senate, which permit amendments to be offered on the floor, it is probable that determined efforts will be made there to reduce the present 27½ percent depletion allowance for gas and oil, with attacks on the rates for other minerals also possible.

FEDERAL STRIP-MINE STUDY ASKED

Senator Hugh Scott (Rep.), Congressmen John Saylor (Rep.) and Thomas Morgan (Dem.), all from Pennsylvania, have introduced legislation which would require the Secretary of the Interior to make a study of strip-mining operations in the United States to determine "extent and effect" of these operations. The information developed, together with any recommendations of the Secretary, would be reported to Congress within two years as an aid in determining what "remedial action" could be taken by Congress and the States.

In conducting the study, the Secretary would be required to cover these matters: (1) The nature and extent of strip-mining operations, (2) ownership of the real property involved, (3) hazards to public health and safety resulting from such operations, (4) the effect of the operations on scenic features and on fish and wildlife, and (5) the public interest in and public benefits which may result "from the appropriate development and use of areas subjected to strip-mining operations." The proposed legislation has been referred to the respective Interior Committees.

LIBERALIZED UNEMPLOYMENT BENEFITS PROPOSED

Another item of interest to the mining industry is the heavy tide of bills to greatly liberalize the nationwide standards for unemployment compensation. Some 125 members of the House have announced their intention of supporting legislation of this nature, and similar legislation, with 32 cosponsors, has been dropped in the Senate hopper.

It would appear that the intent of such legislation is to spread unemployment benefits as widely as possible, irrespective of any presumption of real need or substantial loss of wages. In all the States the proposed maximum benefit entitlement would be practically double what it is now, and in nine States there would be more than a three-fold increase. There are other provisions proposed, to authorize the States to make flat rate reductions in all employer taxes, and to permit Federal grants to States with depleted unemployment compensation funds. These would remove or seriously restrict incentives to stabilize employment, and appear intended to terminate experience rating.

TVA BILL UP AGAIN

The coal industry is watching proposed legislation in both houses of Congress to authorize the Tennessee Valley Authority to sell $750 million in bonds to finance expansion of its power program. It would authorize expansion of the present TVA service area, and would weaken existing controls over TVA operations by Treasury, the Budget Bureau, the Comptroller General and Congress.

PRICE DISCRIMINATION HEARINGS SET

Legislation to limit the "good faith" defense against charges of price discrimination under the Robinson-Patman Act have been tentatively scheduled to begin March 17 by the Senate Antitrust Subcommittee.

Senator Kefauver (Dem., Tenn.), one of the 20 Senators who introduced the bill, said the hearings would also include consideration of the bill by Senator Homer Capehart (Rep., Ind.) (S. 138) which would have the opposite effect in that it would make the meeting of a competitor's lower prices a complete defense against charges of price discrimination.

MERGER LEGISLATION ADVANCES

A renewed effort to enact a premerger notification bill seems to be getting under way in the Senate. At its first meeting of the session, the Senate Antitrust Subcommmittee reported such legislation to the full Judiciary Committee without amendment and without hearings.

The measure, off to an early start, and which is given a good chance of enactment, was introduced by Senators O'Mahoney (Dem., Wyo.) and Kefauver. It is similar to a bill introduced by Chairman Celler (Dem., N. Y.) of the House Judiciary Committee, but the Senate bill is more restrictive than the House measure in several respects. Both bills, as well as another by Senator Wiley representing the Administration's views, require 60 days advance notice to the Justice Department and the Federal Trade Commission when combined corporate assets in planned mergers or acquisitions exceed $10 million.

The O'Mahoney-Kefauver bill, however, exempts stock transactions only up to $1 million, while the other two have a $2 million stock exemption. And the bill by the two Senators requires notification when either party is in interstate commerce, while the Celler and the Administration bills retain the standard that both parties be in interstate commerce.

The Administration proposal does not contain a controversial section appearing in the other two bills which would allow the FTC to seek injunctive relief in the courts in order to forestall mergers considered adverse to the public interest.

All of the proposals for premerger notification provide an exemption from the notification requirement for acquisitions of undeveloped or partially developed mineral, mining or timberland properties.

FEDERAL INSPECTION OF METAL MINES AND QUARRIES PROPOSED

Several Senators and Congressmen have again introduced bills which would authorize the Federal Government to make periodic inspections of metallic and nonmetallic mines and quarries, but neither Senate nor House Labor Committee has indicated whether hearings will be held.

Similar measures were introduced in the 84th and 85th Congresses, and extensive hearings were held on the House side. Appearing in opposition were spokesmen for the U. S. Bureau of Mines, American Mining Congress, American Iron Ore Association, and State mining organizations. Although the bills were strongly supported by the Mine, Mill, and Smelter Workers Union and the United Steel Workers, no further action was taken.

The proposed legislation would empower the Secretary of the Interior, acting through the Bureau of Mines, to make inspections in all mines other than coal or lignite to obtain information relating to health and safety conditions and causes of accidents or occupational diseases. The resulting information would be published and would serve as a basis for Congressional consideration in legislative matters involving health and safety conditions.

Any mine operator who refused to admit an authorized inspector would be guilty of a misdemeanor. Opera-

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personals

The Anaconda Co. has announced the following:

J. B. Knaebel

John B. Knaebel has been appointed president and managing director of Anaconda Iron Ore (Ontario) Ltd., a subsidiary of the Anaconda Company (Canada) Ltd. A mining engineer and geologist, Knaebel has been associated with Anaconda since 1946, and has headed many of its exploration projects in the western hemisphere. He is credited with the discovery of the famous Jackpile uranium mine near Grants, N. M.

C. P. Donohoe

R. C. Wood

Carroll P. Donohoe has been elected president and general manager of Cananea Consolidated Copper Co., S. A., a 99 percent-owned subsidiary of Anaconda. Donohoe, who commenced his career with the organization as a chemist at Anaconda, Mont., in 1925, succeeds **Albert Mendelsohn,** retired. **Robert C. Weed,** formerly general superintendent, has been named vice president and assistant general manager, and **George E. Morris** has been elevated to the position of general superintendent.

Alfred D. Rood formerly with Anaconda's Mining Department has been named assistant to the vice president of Andes Copper Mining Co. and Chile Exploration Co. He succeeds **Douglas M. Dunbar,** retired. Rood has been associated with the mining operations of Anaconda and its affiliates since 1925 at properties in Arizona, Montana, and Potrerillos, Chile. He has been in the New York City headquarters of the company since 1957.

Julian Hayes has been appointed publicity manager of the Anaconda Co. He has been connected with the organization's sales promotion, advertising and publicity activities since 1937.

Alex D. Chisholm, partner in Pickands Mather & Co., large iron ore and coal producer, has announced his retirement. Chisholm, who has been with Pickands Mather for 55 years, became a partner in 1942 and in 1955 was made an associate managing partner.

American Smelting & Refining Co. has announced two executive changes. **Edward McL. Tittmann** has been elected a vice president and director. He will be in charge of Asarco's smelting and refining operations. Earlier, Tittmann had been elected chairman of the board and chief executive officer of Southern Peru Copper Corp. and **Kuno H. Doerr, Jr.** was elected president. Asarco holds a majority interest in Southern Peru Copper.

A 29-year employe of the company, Tittmann started as a chemist in the laboratory of the Garfield, Utah, copper smelter. Following a series of advancements he was named general manager of the Western Smelting and Refining Department in 1952, and assumed the presidency of Southern Peru in 1955.

Doerr's career parallels that of Tittmann's in that he, too, rose through the ranks from a chemist at Garfield. Before taking his new post, he had served as manager of the Garfield smelter and as president of the Garfield Manufacturing Co.

Donald E. Hartman has been named general manager of Pennsylvania Coal & Coke Corp., a division of Penn-Texas. He succeeds **Thomas L. Aitken** who recently retired after 45 years in the mining industry. Aitken will remain with Pennsylvania Coal & Coke in an advisory capacity.

H. A. Lever, chief mining engineer for the Minnesota Division of Lands and Minerals for the past 14 years, retired in December. He was succeeded by **Roy C. Pascoe,** assistant chief mining engineer of the division for the past 10 years.

The retirement of **Henry F. Warden** as vice president of Pocahontas Fuel Co. Division of Consolidation Coal Co. has been announced. Warden was president of Atwater Co. when it was purchased by Pocahontas in 1955.

The appointment of **Edwin A. Slover** as general manager of Chino Mines Division, Kennecott Copper Corp., at Hurley, N. M., has been announced. Slover joined Chino Mines Division in 1939 to start up a new smelter, and became the division's first smelter superintendent. In 1953 he became assistant general manager. As the newly-named general manager, he succeeds **W. H. Goodrich** who recently retired.

Pittsburgh and Fairmont Coal Co. has announced the resignation of **W. P. Shoff** as president. **Thomas E. Pease,** assistant to the president, has assumed full charge of all functions of the company.

Appointment of **I. K. MacGregor** as vice president-staff operations, American Metal Climax, Inc., has been announced. MacGregor had formerly served as vice president-eastern operations of the corporation's Climax Molybdenum Co. Division.

William C. Marland, former governor of West Virginia, has been appointed to the Chicago office of West Kentucky Coal Co. as director of sales of the northern division.

American Zinc, Lead and Smelting Co. has announced the following personnel changes.

R. E. Calhoun

R. E. Calhoun has been promoted to manager of mining operations for the parent company and all operating subsidiary companies. Since 1955 Calhoun has served as western manager for American Zinc, Lead and Smelting Co.

L. P. Davidson, manager, American Zinc Co. of Illinois, retired at the end of February. He was succeeded by **Thomas I. Moore** who had been general superintendent of American Zinc Co. of Illinois since 1952.

H. W. Meador, Sr., has retired as vice president of Stonega Coke and Coal Co. at Big Stone Gap, Va.

E. M. Furness has been advanced to the position of assistant executive vice president, a newly created post, of Reserve Mining Co. Furness had been superintendent of Reserve's crushing and concentrating department.

At the same time it was announced that **Merlyn Woodle,** who had been acting as manager of the Babbitt Division since mid-1958, has been appointed manager.

Three personnel advancements at the Silver Bay Division of Reserve Mining Co. have been announced. **James A. Reynolds** has been named superintendent of the Crushing and Concentrating Department, **William P. Pearson** was named assistant superintendent of that department, and **L. S. Molinaro** has been named superintendent of the Mechanical Maintenance Department.

Steve Gergley, Jr., has been named superintendent of the No. 9 coal mine of U. S. Steel Corp. at Gary, W. Va. He succeeds **Thomas N. McKenna,** retired. At the same time it was announced that **Donald A. Riffe** had been made general mine foreman.

C. E. Bartlett has been named resident manager of Reynolds Metals Company's bauxite mine in British Guiana.

D. G. Werner has been named maintenance engineer for Pittsburgh Coal Co. with offices at Library, Pa. Werner joined Pittsburgh Coal in 1936, and since 1949 has been in charge of the Mathies Preparation Plant.

Alden J. Teske has joined the staff of the Idaho Mining Association. Teske had been editor of *The Wallace Miner* since 1949.

Youngstown Sheet & Tube Co. has appointed **Robert P. Bremner** to the newly created post of vice president in charge of raw materials. Bremner formerly was assistant vice president and was in charge of mining properties.

Joseph Kristoff has assumed the duties of superintendent at the Oakmont mine of Harmar Coal Co. For the last three years Kristoff has been mine foreman at the Montour No. 4 mine of Pittsburgh Coal Co.

George F. Weaton, Jr., has been appointed director of Ore Reserve Estimates for the School of Mines & Metallurgy of the University of Minnesota.

Samuel K. Scovil has been appointed manager of Ore Sales Department of Cleveland-Cliffs Iron Co.

Following sale of stock in the Lucky Friday Silver-Lead Mining Co. to Hecla Mining Co., **Charles E. Horning,** president and **John A. Featherstone,** vice president of Lucky Friday, have announced their resignation. **L. J. Randall,** president of Hecla, succeeds Horning and **Harry F. Magnuson** succeeds Featherstone. **William H. Love** was appointed general manager. Randall and Love were also elected to Lucky Friday's board of directors.

Walter J. Williams, Cleveland manager of construction and development for Pickands Mather & Co., has recently been named president of Manganese Chemical Corp. of Minnesota, a firm associated with PM, in addition to his regular duties.

Roy C. Bonebrake has resigned as vice president and secretary of Magma-Copper Co. to become chairman, a newly created office, for Magma and San Manuel Copper Corp., a subsidiary.

Three senior mining appointments have been announced by Consolidated Mining and Smelting Co. of Canada. **B. E. Hurdle** was promoted from assistant manager of mines to manager of mines, and **L. Telfer** from superintendent of exploration to manager of exploration. **G. N. Moore** is now general superintendent of exploration.

Oscar D. McDaniel, Jr., was recently promoted to superintendent of Mine No. 9 for Old Ben Coal Corp.

Henry W. Nichols has joined Bunker Hill Co. at Kellogg, Idaho, as industrial relations administrator. For the past five years he has been industrial relations manager for Westvaco Mineral Products Division of Food Machinery and Chemical Corp. at Pocatello, Idaho.

Peter E. Caron has been named manager of the By-Product Sales Department of American Smelting and Refining Co. He succeeds **Donald K. Wright** who retired January 1 after 34 years of service with the company.

William P. Morris has been appointed general manager of New York and Honduras Rosario Mining Co. with headquarters in Honduras. **Edward T. Knight** has been named vice president of the company's subsidiary, Rosario Explorations, Ltd., in Montreal.

— *Obituaries* —

Paul Reese Maxey, 57, chief engineer of coal mines for Armco Steel Corp. passed away January 2 at Charleston, W. Va.

Mr. Maxey began his career with Armco in the engineering department at Nellis, W. Va., in 1926. He served as general mine foreman, and mine superintendent before being named chief engineer.

C. C. Dickinson, Jr., 53, widely known in the coal industry of West Virginia, died in Tucson, Ariz., January 14.

Mr. Dickinson was vice president of Dickinson Fuel Co., and its affiliated interests, a past president of the Kanawha Coal Operators Association, and a long time director of the Southern Coal Producers Association.

Joseph A. Norden, 65, widely known Utah mining man, died January 7 at Beverly Hills, Calif. Mr. Norden was employed by Utah-Apex Mining Co. and its successor, National Tunnel and Mines Co., Bingham, Utah, in various engineering and related capacities for 30 years. In 1942 he moved to Vermont where he reopened and rehabilitated the Elizabeth Copper mine. From 1947 until its sale in 1958, he operated the Redbird mine near Clayton, Idaho, in which he was a part owner.

Sterling C. Moon, 56, head of mining research and development for **Jeffrey Mfg. Co.,** was killed in an automobile accident January 10.

Irving D. Cook, 63, former president of Red Jacket Coal Co., died January 2 in Cleveland, Ohio. Mr. Cook, a native of Canada, founded Red Jacket in 1924 and headed it until 1935.

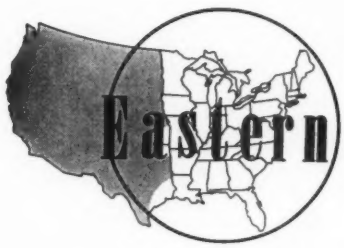
Roy Elsmere O'Brien, 60, long associated with mining in the West, died January 9 in Salt Lake City.

Mr. O'Brien began his mining career in 1925 at Green Cananea Consolidated Copper Co. in Mexico. In 1928 he moved to Rio Tinto, Nev., where he became mine superintendent for Mountain City Copper Co. Following service in the Salt Lake City office of International Smelting & Refining Co., and at the phosphate division of The Anaconda Co., he was made the first western secretary of the American Institute of Mining, Metallurgical and Petroleum Engineers in 1950.

Randolph Bellsmith, 73, retired mining engineer, died January 27 in Tucson, Ariz. Mr. Bellsmith had served as chairman of the Tucson Council of Small Mine Operators for three years. Previously he had been employed by Phelps-Dodge Corp.

Leo S. Hayes, an engineer for American Smelting and Refining Co., died of a heart attack at his home in Tucson, Ariz., January 31. Mr. Hayes worked at Jerome in 1923 and 1924 and then spent about 15 years on various assignments in South America. During the war he was with the Office of Price Administration in Washington and was subsequently employed in the New York and Tucson offices of Asarco.

NEWS and views



Railroad to Be Constructed to Labrador Ore Site

Pickands Mather & Co. has announced its first major move in development of the huge Canadian Javelin, Ltd., iron ore deposit in the Wabush Lake and surrounding areas of Labrador. The Cleveland company said initial contracts are being set for construction by Wabush Lake Railway Co., Ltd., of a railroad into the Wabush Lake area. Engineering and surveying work is expected to begin shortly. It is expected that the railroad will cover a minimum of 42 miles and will connect with the Quebec, North Shore & Labrador Railway.

Anaconda Continues Exploration of Western Ontario Iron Ore Deposit

John P. Knaebel, the Anaconda Co., has actively assumed his new duties as president and managing director of Anaconda Iron Ore (Ontario) Ltd., by making preparations for testing and further exploration of the company's sizable iron ore properties north of Lake Superior. The ore, suitable for metallurgical treatment into high grade concentrates, is similar to that found in New York State. The properties are located near Nakina, Ontario. According to Clyde Weed, chairman of the board of the Anaconda Co. it is not the intention of the company to bring this property into production at this time, as there are many things occurring in the iron ore industry which the concern wishes to examine thoroughly before committing itself to the vast expenditures which must be made in such a venture.

Shovel Has 160-Ft Boom

Superior Marquette Co. has put into operation in a southern Ohio quarry a shovel weighing 1499 tons. The machine has an 11-yd bucket and 160-ft boom; the boom is said to be the longest of any shovel in the country. Employing motors of 1600-hp capacity, the shovel has a dumping radius of 158 ft and a cutting height of 13 ft.

George H. Love, Chairman of the Board, Consolidation Coal Co., announced the formation of the new group. Shown with him are, (from left to right) H. C. Murphy, President, Burlington Lines; H. E. Simpson, President, B&O Railway Co.; and Thomas Kennedy, Vice President, United Mine Workers

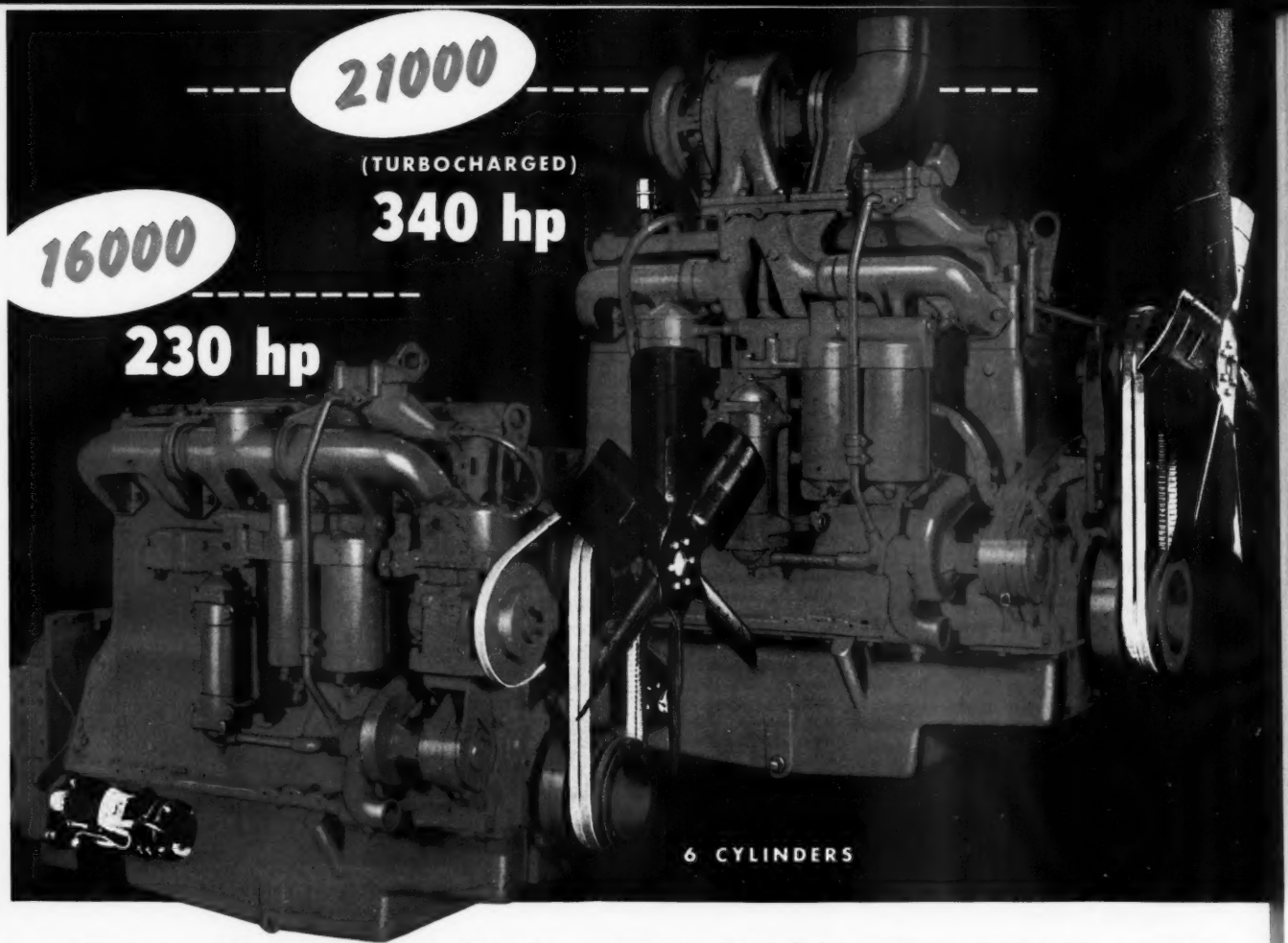
National Coal Policy Conference Organized

Management, labor and related groups in the bituminous coal industry have formed an over-all organization designed to advance and promote the interest of the industry on the broadest possible front.

Establishment of the National Coal Policy Conference, organized and supported by the United Mine Workers, bituminous coal operators, coal-carrying railroads, coal-using electric utilities, and some industry equipment suppliers, was announced February 25 by George H. Love, Chairman of the Board, Consolidation Coal Co., Pittsburgh, Pa. Creation of an organization similar to the one now established was suggested by John L. Lewis, President of the United Mine Workers, in an address before the Coal Convention of the American Mining Congress in Cincinnati last May.

Among the objectives of the Conference are the following: an intensive educational campaign to acquaint the public with the vital importance of the coal industry to the national welfare; broadening of domestic and export markets; promotion of research into the production, marketing and utilization of coal; creation of a positive, creative Government policy toward the industry; an increase in coal's depletion allowance; action to stop excessive importation of residual oil and below-cost industrial sales of natural gas, and formulation of broad policies in the coal industry on matters agreed upon by the coal industry group.

Joseph E. Moody, President, Southern Coal Producers' Association, has been named executive director of the Conference. George Love is Chairman, and members of the executive committee include, from the ranks of coal operators, F. S. Elfred, Chairman of the Board, Peabody Coal Co.; Harry LaViers, President, South-East Coal Co.; C. J. Potter, President, Rochester & Pittsburgh Coal Co.; Raymond E. Salvati, President, Island Creek Coal Co., and President of the American Mining Congress; and Kenneth A. Spencer, President, Pittsburg & Midway Coal Mining Co. The United Mine Workers of America are represented on the executive committee by John L. Lewis, President; Thomas Kennedy, Vice President and Michael Widman, Jr., Assistant to the President. The railroad industry is represented by H. C. Murphy, President and Executive Committee Chairman, Burlington Lines; H. E. Simpson, President, Baltimore & Ohio Railway Co., and John Tilford, President, Louisville and Nashville Railroad Co. Philip Sporn, President of American Electric Power Service Corp., represents the electric utilities. Coal industry equipment suppliers are represented by J. H. Fulford, President, Jeffrey Manufacturing Co., and W. L. Wearly, President, Joy Manufacturing Co.



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. . . throughout the operating range of speeds. Torque is consistently high . . . provides the "umph" to do the job. Walks into and *through* heavy loads.

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This chart compares fuel economy of the new Allis-Chalmers engines to others in their horsepower class. Economy like this gives you as much as from 1 to 2½ hours of extra production a day doing the same kind of work — using even less fuel.

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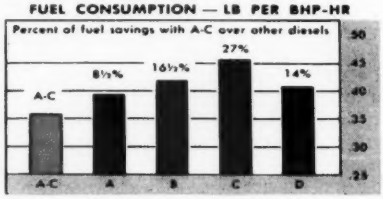

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First Casting Made of Molybdenum

Government scientists have produced the first shaped casting of molybdenum. The Interior Department, in announcing the successful casting, described it as a major metallurgical development of importance to the Nation's space missile programs. Marling J. Ankeny, director of the Bureau of Mines, said scientists at the agency's Albany, Ore., laboratory had produced a simple hollow cylindrical molybdenum casting. He said the metallurgists are now trying to improve techniques so intricate shapes can be created for the development of missiles, rockets and satellites. Under remote-control conditions in an inert atmosphere, the Bureau metallurgists used a high-density electric arc and melted a 30-lb charge of molybdenum in a water-cooled, copper-lined melting pot.

Climax Molybdenum Co., division of American Metal Climax, Inc., is cooperating fully with the Bureau in its experiments and has agreed to supply the Albany laboratory with necessary molybdenum raw materials.

Ohio Salt Mine to Open

Morton Salt Company's new operation at Grand River, near Fairport, Ohio, went into operation early in February. The mine will aim at producing 1,000,000 tons of salt annually, but will be capable of up to 2,000,000 tons a year if the demand develops. Production will be about 500 tph in mining operations that will be similar to mining coal.

The 20-ft vein of salt lies 1920 ft below the surface, and two shafts — a 16-ft diameter production shaft, and a 12-ft personnel shaft — have been sunk. The salt mine will employ 100 to 200 workmen, about half working underground. Diesel trucks will haul the salt to the shaft.

J & L to Open New Iron Ore Mine

Jones & Laughlin Steel Corp. has started preparing a major iron ore mine for production by April 1960. The operation is in Minnesota at the western end of the Mesabi Range and about midway between Grand Rapids and Coleraine. It will consist of two open pits, one on each side of the Prairie River. They will be connected by a bridge. The Lind-Greenway Mine is expected to produce about 700,000 gross tons of beneficiated ore a year, or about 10 percent of J & L's blast-furnace requirements.

Island Creek Buys Five Mines

Island Creek Coal Co. has acquired the mining properties and lease-holds of Guyan Eagle Coal Co. and Elk Creek Coal Co. The properties acquired include mines No. 1, 4 and 5 of Guyan Eagle and mines No. 1 and 4 of Elk Creek, all situated in Logan County, W. Va. The mines are served by Chesapeake & Ohio Railway and have an annual productive capacity of 4,000,000 tons. Hubert H. Barber has been appointed manager of Island Creek's new Guyan division.

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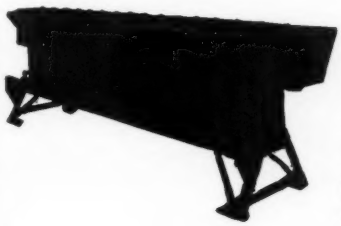

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Ormet Dedicates Alumina Facility

Joint dedication ceremonies were recently held at Baton Rouge, La., to mark the official completion of the Burnside Bulk Marine Terminal and the nearby Ormet Corp. alumina works. The two projects represent a capital investment of more than $70,000,000.

Completion of this final link in the flow line provides an unbroken line of supply from mine to consumer product. Ore will originate in the bauxite fields of South America, move by ocean carrier to Burnside and the Ormet plant, be transhipped as alumina by river barge to the company's works in Ohio for reduction into primary aluminum. Rated capacity of Ormet's plants are 345,000 tons of alumina and 180,000 tons of primary aluminum annually.

ALSO . . .

West Germany's coal production decreased by only half a million tons in 1958, despite long layoffs and increasing selling difficulties. Official statistics put 1958 production at 132,570,000 tons against 133,160,000 in 1957.

Saint-Gobain Corp. of France plans to break ground for a $40,000,000 plant somewhere in the Ohio Valley this year, according to *Business Week*. One of the largest glass companies in the world, Saint-Gobain is affiliating with Blue Ridge Glass Co. of Kingsport, Tenn., and American Window Glass Co., Pittsburgh, Pa., in a new company — American Saint-Gobain Corp., which will operate the new facility. Expected to be important factors in Saint-Gobain's decision on the plant location are the recently discovered deposits of high-grade silica in Kentucky.

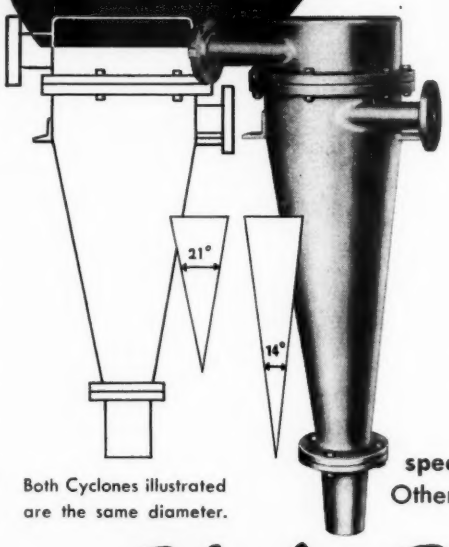
Officials of the Fairmont, W. Va., Junior Chamber of Commerce have outlined plans for a $5,000,000 coal shrine. Plans call for the shrine to house a museum, a coal "hall of fame," a library and an auditorium. Also planned is the erection of a model mine. The memorial would honor the coal industry for its contributions to the development and growth of the nation.

In a year-end report, Dr. Clarence H. Lorig, president of American Society for Metals, and technical director of Battelle Memorial Institute in Columbus, Ohio, said that melting metals in jets of heat ranging up to 30,000°F, steels with strength exceeding 40,000 psi, perfection of techniques for the forming of metal parts by controlled explosions and the rolling of metal strip directly from metal powders are among the outstanding metal engineering developments of 1958.

Brimac Corp. has purchased mineral rights on a large area of land near Carbonton, N. C., and plans to develop a strip mining operation. Twenty tons of sample anthracite coal have been mined and used in two local business concerns' boilers to test the coal.

Steamer HERBERT C. JACKSON, a 24,000-ton capacity iron ore freighter, was launched February 19 at River Rouge, Mich. Sponsoring the ship at impressive christening ceremonies was Mrs. Jackson, of Cleveland, wife of the ship's namesake. Herbert Jackson is vice president and director of Interlake Steamship Co., owner of the ship, and a managing partner of Pickands, Mather & Co. He is also a vice president of American Mining Congress, chairman and director of American Iron Ore Association, and a director of Lake Carriers' Association.

H&P cyclones



Both Cyclones illustrated are the same diameter.

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OPERATORS' CORNER

(Continued from page 72)

as sensitive as the AN-fuel mixture and therefore it is safer in the borehole. The detonation rate of the slurry is about twice that of the AN-fuel. The explosion pressure for slurry, which in turn reflects borehole pressure, is over three times that of the AN-fuel mixture.

The slurry has the consistency of a very thick pea soup. It can be poured down dry boreholes and of course completely fills the hole. It should be pointed out that if the borehole leaks and the water runs out of the mixture the borehole pressure is reduced about 30 percent. To overcome this problem a water flow retarder can be added to make the slurry thick enough so that the water will not run off. Another convenient way to overcome this problem is by loading the material in a polythene or other leak proof sack. Handling of sacks does add to the loading costs, but by retaining the water in the slurry the full borehole pressure is developed. In wet boreholes or those having standing water, the slurry can be pumped or blown by air through a large hose to the bottom of the hole. This pumping or blowing is similar to a pneumatic grout placing operation. Again, as in the dry hole, the mixture can be placed in a bag and dropped through the water. If the hole is water-filled, the bag can be made of porous or water disintegrating material. The only requirement of the bag is to carry the slurry mixture down through the water without allowing segregation of the AN and TNT.

Slurry Improves Fragmentation

Assuming the cost of AN is four cents per lb and TNT 22 cents per lb, the slurry costs 1.75 times more than the AN and fuel oil. When using slurry for blasting hard rock or wet holes the company found it was possible to increase the spacing and burden. The increased spacing and burden produced 1.7 times more broken rock per ft of borehole. In some cases the same powder factor had to be maintained with the increased spacing. The fragmentation in hard rock has been considerably better with the slurry than with the AN-fuel mixtures. In hard rock drilling the additional cost of the slurry has been more than offset by the savings made in drill bit cost per yd.

Thus, another tool has been added to the hard rock blaster's kit. This explosive is not intended to replace ammonium nitrate and fuel oil, but it is another member of the ammonium nitrate explosive family that will help the mining industry produce more and cheaper blasted rock.

Two privately owned companies have been purchased by Howe Sound Co. Austenal, Inc, which employs 1500 persons in plants in New York City, Dover, N. J., Chicago and La Porte, Ind., and Stamford Rolling Mills Co. which operates a big copper, brass and bronze rolling mill in Springdale, Conn., are expected to do about $35,000,000 of business this year. Austenal is a pioneer in precision castings of high temperature alloys, and its principal business is manufacturing blades and vanes for jet engines.

Russia's first fully automatic coal mine, to be run by remote control, will start operating in the Donbass area of the Ukraine this year, according to the Soviet news agency, Tass. The agency said about 80 automatic machines are being installed and one man will be able to direct the whole production process.

The Ohio Reclamation Association, an organization of coal strip mine operators and producers of other minerals by surface mining, planted a record 2,775,232 trees during 1958. This brought to 24,241,580 the number of trees planted on 27,306 acres since the association was formed in 1945.

West Germany will impose a tax of $4.76 a ton on imported coal beginning February 16, according to Ludwig Erhard, economics minister. This measure was taken to bring prices on coal from abroad, particularly from the United States, into line with the cost of the domestic product. The tax will be effective until December 31. Parliamentary approval was expected. Erhard said that a tax-free quota of 4,250,000 tons would be allowed for the benefit of coastal areas and Bavaria, which are far away from the Ruhr mines. This quota would be filled by imports from the United States, Britain, Czechoslovakia and Poland. (Later reports indicate the quota will be upped with the United States alone being allowed a tax-free quota of 4,355,000 metric tons.)

Westinghouse Electric Corp. has announced it can build a nuclear power plant it believes will produce power at costs competitive with coal and oil in the higher fuel cost areas of the United States. The atomic plant would have a rated capacity of 3330,000 kw, nearly six times the capacity of any commercial nuclear plant now in operation. Westinghouse said it has informed electric utility executives it is prepared to develop, design and manufacture the equipment for such a plant.

The Benson Iron Mines of Jones & Laughlin Steel Corp. in northern New York are working at capacity again after a year of reduced operations.

Book Review

LET'S LOOK AT SOME ROCKS

William J. Wayne, Geological Survey, Indiana Department of Conservation, Bloomington, Ind., 35 cents.

The author has written an excellent little book to help the beginning student of rocks take his first steps into the subject with a little more confidence. The book is simply written, and adequately illustrated. It is of particular value to young people who have had no professional training in rock identification, but have an interest in the subject.

Besides a brief description of common rocks which fall into the three categories of sedimentary, igneous, and metamorphic, the author describes how to make a rock collection, what equipment you will need and provides some highly useful references on rocks and minerals.

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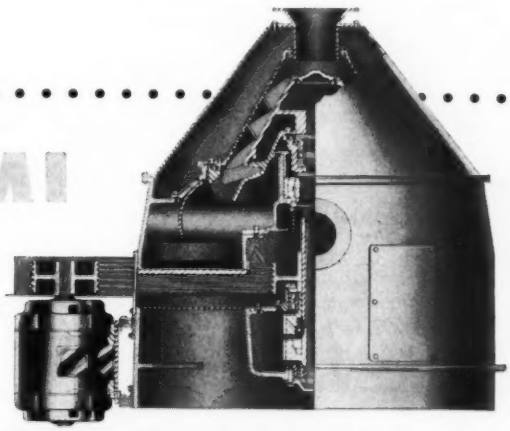

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WHEELS OF GOVERNMENT

(Continued from page 74)

tors would be required to furnish, upon request, full information concerning accidents involving bodily injury or loss of life.

Another requirement would be creation by the Secretary of an advisory committee of not more than six members, equally representing mine owners and mine workers, which would cooperate with the Bureau of Mines in promulgating a code of reasonable standards and rules pertaining to safety and health conditions. This code would then serve as a guide for making recommendations to Congress.

MINING SUBCOMMITTEES NAMED

Subcommittees which will handle mines and mining legislation have been named by Senate and House Interior Committees. The jurisdiction of these subcommittees includes mining interests generally (other than taxation), mineral resources of the public lands, mineral land laws and claims and entries on mineral lands, the U. S. Bureau of Mines, and the Geological Survey.

Democratic members of the Senate Interior Subcommittee on Minerals, Materials, and Fuels are James E. Murray (Mont.), chairman, Joseph C. O'Mahoney (Wyo.), Alan Bible (Nev.), and John A. Carroll (Colo.). Republican members are Henry Dworshak (Idaho) and Thomas E. Martin (Iowa).

The House Interior Subcommittee on Mines and Mining has these Democratic members: Adam C. Powell (N. Y.), chairman, Walter Rogers (Texas), Mrs. Gracie Pfost (Idaho), Ed Edmondson (Okla.), Stewart L. Udall (Ariz.), J. T. Rutherford (Texas), Walter S. Baring (Nev.), Thomas G. Morris (N. M.), Ralph J. Rivers (Alaska), and Wayne N. Aspinall (Colo.), who as chairman of the full committee is an ex-officio member.

Republican members of the House Subcommittee are John P. Saylor (Pa.), J. Ernest Wharton (N. Y.), J. Edgar Chenoweth (Colo.), Harold R. Collier (Ill.), Gardner R. Withrow (Wis.), Bob Wilson (Calif.), and Mrs. Edna Simpson (Ill.).

MERCURY SITUATION REVIEWED

In a report recently filed with Congress, Attorney General William P. Rogers said that Government programs since 1953 to stimulate domestic production of mercury achieved that objective while substantially increasing competition within the domestic industry, but added that the industry's future is precarious.

The mercury report constitutes one of the quarterly reports which the Attorney General must make to Congress in compliance with the Defense Production Act of 1950, which authorized Government action to stimulate production of needed minerals and other commodities.

At the outbreak of the Korean conflict, the report pointed out, domestic production of 6535 flasks of mercury accounted for only 13 percent of domestic consumption in that year. By 1957, production of more than 40,000 flasks represented 75 percent of domestic consumption (not including stockpiling).

The mercury purchase program was terminated December 31, 1958, leaving only the exploration incentives available under the Office of Minerals Exploration program. It is still too early to tell, the report said, how the domestic industry will fare in the open market without some form of direct Government assistance, but commented that the future of the domestic industry "is precariously dependent, not on domestic competition, but upon the course of operations of the richer, more economically worked foreign supplies."

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NEWS and views

Major Phosphorous Industry Predicted for Idaho

A major phosphorous industry is predicted for Idaho by Ernest Hart, president of Food Machinery & Chemical Corp., parent company of Westvaco Mineral Productions Division which operates a plant west of Pocatello.

Various processes for the separation of phosphate ore from waste shale are being tested, Hart explained, in an effort to develop the best process of beneficiation so that the huge low-grade phosphate deposits on the Fort Hall Reservation can be utilized profitably. When perfected, FMC will build a plant at the property.

At present only high quality phosphate rock is shipped to the Westvaco plant where it is turned into elemental phophorous for shipment to other FMC plants and subsequent processing into saleable elements, a major share of which goes into the manufacture of detergents. These surface deposits, Hart stated, will become exhausted sometime in the future, as will similar deposits in Florida and other parts of the world. When they do, Idaho's deep reserves will have come into their own.

Northeastern Washington Production Figures Released

For the first time, the U. S. Bureau of Mines is releasing production figures of individual mines which the bureau has collected over more than half a century. Marling J. Ankeny, director of the bureau, made the following statement about *Mine Production of Gold, Silver, Copper, Lead and Zinc in Pend Oreille and Stevens Counties, Wash., 1902-56 Information Circular 7872:* "The information contained in this report was gathered on a confidential basis and originally published so as not to reveal how individual operations were faring. Most mine owners and operators now have released the Bureau from its pledge of confidence. These old figures are the very ones most useful to those trying to expand production through reviving latent resources. Many of the mines to which the data apply have been idle for years, and are inaccessible, their entries caved, or their workings flooded." Pend Oreille and Stevens counties have produced more than $114,000,000 worth of the five nonferrous metals during the period covered by this report.

ALSO . . .

An economical method of extracting alumina from clay, which The Anaconda Co. has been developing for several years, is nearing the final stages of pilot plant experimentation. Company officials estimate that it will be another six months before a final assessment of the process can be made. Anaconda has been operating a 50-tpd pilot plant at Anaconda, Mont. using clays from Latah County, Idaho.

The new fertilizer plant that The Bunker Hill Co. is planning to construct in the Pacific Northwest is now in the design stage, with construction tentatively scheduled to start later this year. Dorr-Oliver, Inc., of Stamford, Conn., has been contracted to do the preliminary engineering work. The company is presently studying transportation problems and has not yet announced a decision as to where the plant will be located. The $10,000,000 plant will begin operations in 1960.

Federal Uranium Corp. has announced selection of Western-Knapp Engineering Co., as prime contractor on Federal's $3,000.000 uranium mill in Wyoming's Gas Hills District. Engineering work is already under way. Construction of the 522-tpd uranium concentrator which will be built some 50 miles east of Riverton, Wyo., near large ore bodies controlled by Federal, will start April 1, with completion scheduled by Dec. 1959.

Associated with Federal in the venture are Gas Hills Uranium Co. and Radorock Resources, Inc., a Federal subsidiary. The new mill also will process custom ores from other companies.

The Second Protective Construction Symposium will be held at the Rand Corporation, 1700 Main St., Santa Monica, Calif., March 24-26. The symposium will stress design and construction of deep underground facilities to resist the effects of surface explosions. Company officials believe that many of the problems of underground construction that now appear to be difficult will be solved when people begin to think more about them, and hope that this symposium will stimulate such thinking. Everyone interested in the field of protective underground construction is invited to attend. Contact J. J. O'Sullivan, symposium chairman at the above address.

The Church Rock uranium mining area northeast of Gallup, N. M., which contains an estimated $23,000,000 worth of ore, is scheduled to start operating this year, according to a report from the Quinta Corp. and Phillips Petroleum Co., joint owners of the mineral rights. The AEC has agreed to buy ore from the area through 1966, and has assigned annual production limits of 141,000 tons of ore and 592,000 pounds of U_3O_8. Daily production of 450 tons is predicted.

The international interest in gold has sparked a boom in the sale of mechanical gold pans manufactured by Denver Equipment Co. The company has been making the mechanical gold panners for more than 30 years, but interest in the small gold recovery machines has hit an all-time high in recent months.

The pan has a gasoline engine and a water pump. It duplicates hand-held panning and washing action, and has a nugget trap, two matting trays and an amalgamation plate. They are capable of handling 20 yards of dirt per day, compared to a maximum one yard in a hand operation. The pans are especially popular in Africa and South and Central America where unskilled labor is plentiful and mining costs are low, but one man in Goldfield, Nev., wrote the company last summer that he had made $50,000 in one year using the device.

EXIDE-IRONCLAD BATTERIES

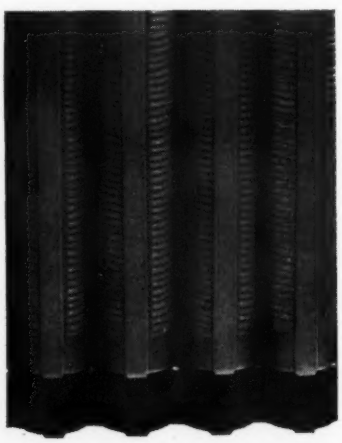
—best buy for the long haul

More ton-miles per dollar—that's the reason most cost-conscious mine operators prefer Exide-Ironclad Batteries for mine locomotives.

Experience has proved over the years that no other battery make matches Exide-Ironclad for average life in service and tonnage hauled. Rating for rating and dollar for dollar, Exide-Ironclad gives you more real value . . . more return on your investment.

Today's Exide-Ironclad features improved tubular construction, making it even better than the models that chalked up the industry's records. So you can expect even longer life potential and superior performance.

Total work output, not mere price, is the key to battery economy. When you buy batteries, specify Exide-Ironclad and get the most production capacity your dollar can buy. For details, write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 20, Pa.



50 years ago, Exide patented the now-famous Exide-Ironclad tubular positive plate battery. For power and economy, nothing has ever matched it. Yet Exide engineers have constantly improved it. Today's battery packs more power, gives longer life and greater economy than ever before.

Exide®

Southern Pacific Railroad is planning a $250,000 mineral survey of its land east of Lovelock, Nev., where geologists report discovery of an extensive iron ore deposit. About 40,000 ft of diamond drilling, sampling and drill core logging have been planned for some 50 square miles of land in Buena Vista valley, about 25 miles east of Lovelock.

A high-grade orebody has been uncovered recently at Manganese, Inc., near Henderson, Nev., that will keep the company in operation for several months.

Shaft sinking at the Elizabeth Adoor Claim in the Ambrosia Lake District, N. M., will start in March, according to officials of the Parador Mining Co. of San Francisco. The shaft will be sunk to a depth of 1150 feet. Parador has assigned operating leases to Rio De Oro Uranium Mines, Inc., of Albuquerque. Production is scheduled to start in April 1960 and may reach the rate of 10,000 tons per month by the end of that year.

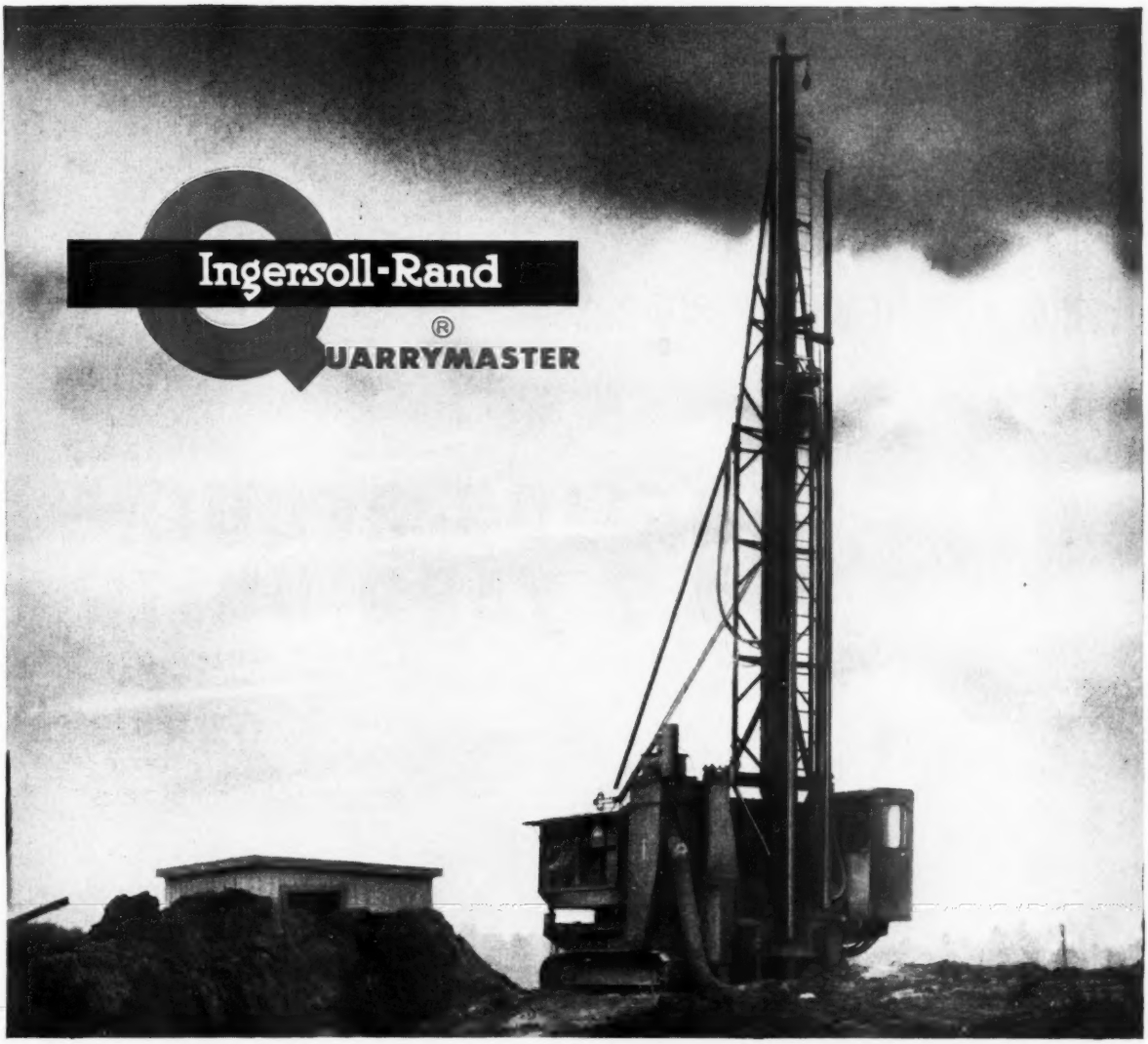
Nabob Silver-Lead Co. and Sidney Mining Co. have concluded an agreement providing for profit sharing production from the Nabob mine in the Pine Creek District of the Coeur d'Alene mining region, and mutual participation in other projects. Under the terms of the five-year renewable operating agreement, Sidney immediately will install the equipment necessary to deepen the Nabob shaft, open a new level and thus place the mine in production.

Many oil men are unenthusiastic about participating in an underground atomic test explosion designed to extract shale oil. The Government has asked the oil industry to help pay for the costs of the tests. Some oil executives feel there are too many unknowns in backing such a test at this time, but almost everyone agrees there is a high potential in this method of shale oil recovery and that it is definitely worth more thought.

American Metal Climax Foundation has given $10,000 to Colorado School of Mines Foundation. The gift will be used to increase faculty research and academic opportunities.

About 500,000 shares of Lucky Friday Silver-Lead Mines' stock, valued at approximately $3,750,000 was recently acquired by Hecla Mining Co., of Wallace, Idaho. Hecla now owns approximately 38% of the outstanding Lucky Friday stock.

Another seven years will be added to the life span of the Lavender Pit mine at Bisbee, Ariz. Phelps Dodge Corp., owner of the mine, has announced a $5,000,000 expansion program which will increase the pit's operation to a total of about 15 years.



"DOWN THE HOLE DRILL" PERFORMANCE

Results in Two Repeat Orders

An Ingersoll-Rand Quarrymaster in Quebec, Canada, is now at work drilling the extremely hard and abrasive quartzite cap rock formation overlying an extensive magnetite iron ore body. This machine utilizing an I-R DHD-400 "down the hole drill" and 7 inch Carset bits has averaged 15 to 20 feet of hole per hour since the unit went into operation last spring.

Test holes in the Magnetite iron ore indicate that overall drilling speed in the ore will be twice that in the cap rock. In the ore body the face height will be 25 feet.

Based on the performance of the first unit over the past six months, two additional units are now on order. Phone or write your I-R man today requesting full particulars on the high tonnage performance of this and other Quarrymaster installations.

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S-747

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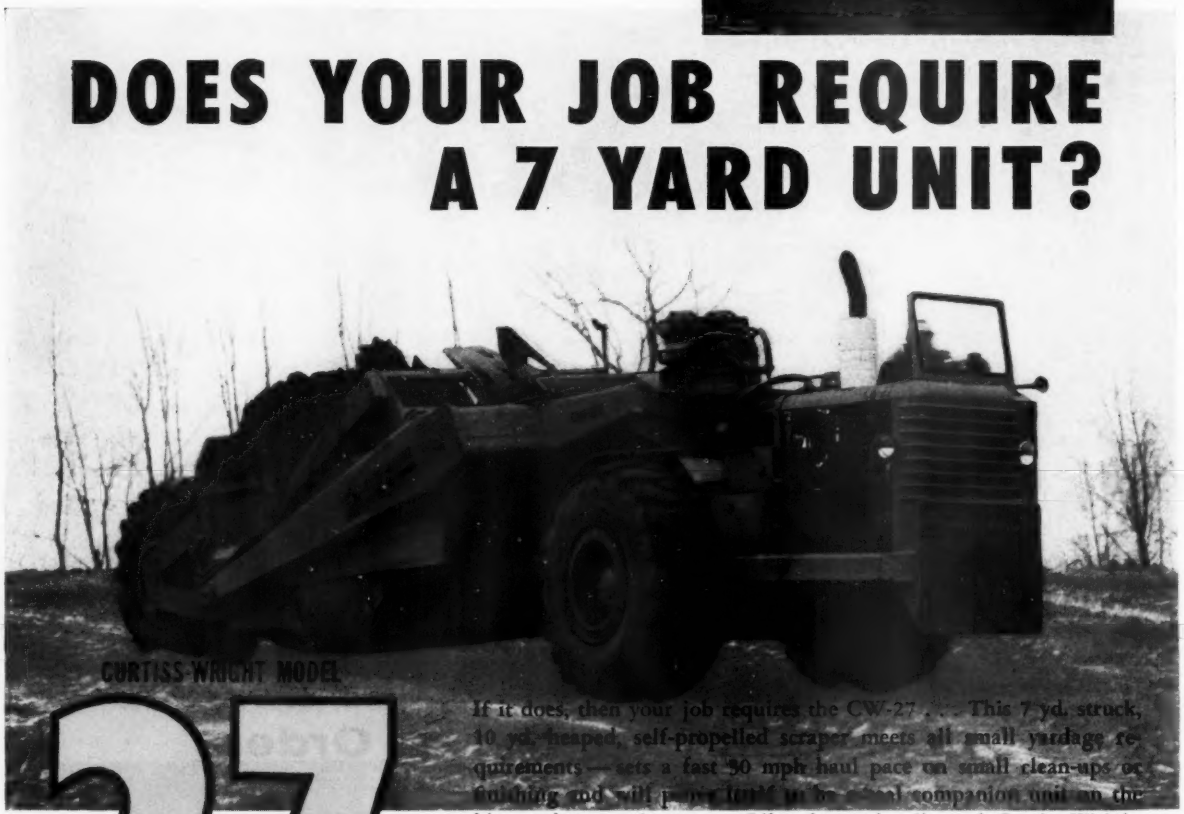
...more profit with every pass

DOES YOUR JOB REQUIRE A 7 YARD UNIT?



CURTISS-WRIGHT MODEL

27

CW-27 SELF-PROPELLED SCRAPER

Capacities: 7 cu. yds. struck, 10 cu. yds. heaped, 26,000 pound rated load

SALES • SERVICE • PARTS at your CURTISS-WRIGHT DISTRIBUTOR

If it does, then your job requires the CW-27 . . . This 7-yd. struck, 10 yd. heaped, self-propelled scraper meets all small yardage requirements — sets a fast 30 mph haul pace on small clean-ups or finishing and will prove [illegible] to be a real companion unit on the big yardage projects . . . Like the entire line of Curtiss-Wright 'plus-yardage' scrapers, the CW-27 boasts such maintenance and production advantages as unit construction, Roto-Gear steer, constant live winch and positive roll-out ejection . . . To insure the utmost from every scraper, Curtiss-Wright engineers to the contractor's requirements . . . To be sure you get the most from all your jobs, check with Curtiss-Wright first!

SOUTH BEND DIV. CURTISS-WRIGHT CORPORATION, SOUTH BEND, INDIANA

SOUTH BEND DIVISION

CURTISS-WRIGHT

CORPORATION

SOUTH BEND, INDIANA

Back to Colorado in '59

The AMC Metal Mining and Industrial Minerals Convention will be held in Denver, September 14-16.

COINCIDENT with Colorado's "Rush to the Rockies" centennial, the mining industry will converge on the mile-high city next fall for the Metal Mining-Industrial Minerals Convention of the American Mining Congress—the most important mining meeting in the West. Plans are taking form under the direction of Cris Dobbins, president of Ideal Cement Co., who is Chairman of the Western Division of AMC.

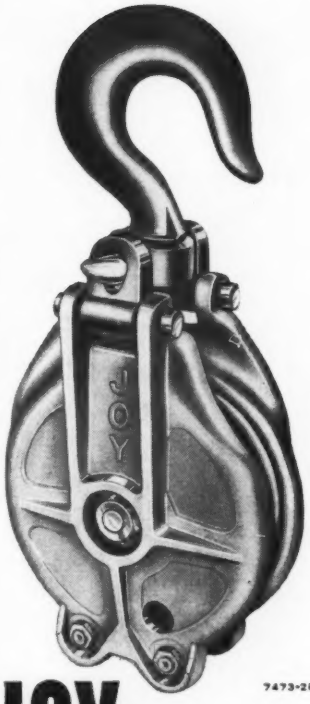
Committee chairmen for the Convention have been appointed—as announced in *Mining Congress Journal* last month—and prominent leaders throughout the nation are lending support and assistance by serving on the various committees.

Included in the program will be discussions of the industry's relationships with Government and labor and mining's place in maintaining America's leadership among nations. Administration officials, members of Congress and top industry leaders will set forth the best thinking on matters of policy.

At the operating sessions, the latest methods and equipment being applied in the extraction and processing of metallic ores and industrial minerals will be fully presented. The program will be of real value to miners on the production line, as well as to supervisors, engineers, managers, executives, and specialists in all fields.

Those who have not applied for hotel reservations should do so promptly. Use the reservation forms recently distributed to the industry, or write to AMC Housing Bureau, Denver Convention and Visitors Bureau, 225 West Colfax Ave., Denver, Colo. Accommodations in Denver have been improved greatly since our last meeting there in 1952. Hotels have been enlarged or modernized, and excellent new motels are available for those who travel by car. But the convention has also grown larger, so act now.

Guy Emerson, president of the Denver Mining Club, places the crown on Miss Gold of 1959, pretty Barbara Jorgensen of Denver. She is Queen of the "Hall of Mining Progress," where the Mining Club has a display of mining subjects for visitors to Denver's Centennial celebration, which marks the 100th anniversary of the discovery of gold in the State



7473-287

JOY quick opening
SHEAVE BLOCKS

forged construction

The hook and side plates of the 6″, 8″ and 10″ sizes are *forged alloy steel.* The wheel is chrome-nickel-moly cast steel. All parts are heat-treated for strength and wear resistance.

simple & rugged

There are no pins, chains, bolts or nuts to handle or remove. TO OPEN JUST TURN AND PUSH . . . no parts leave the block to become lost. The rugged opening mechanism will last for the life of the block.

Write for Bulletin 287-3

JOY

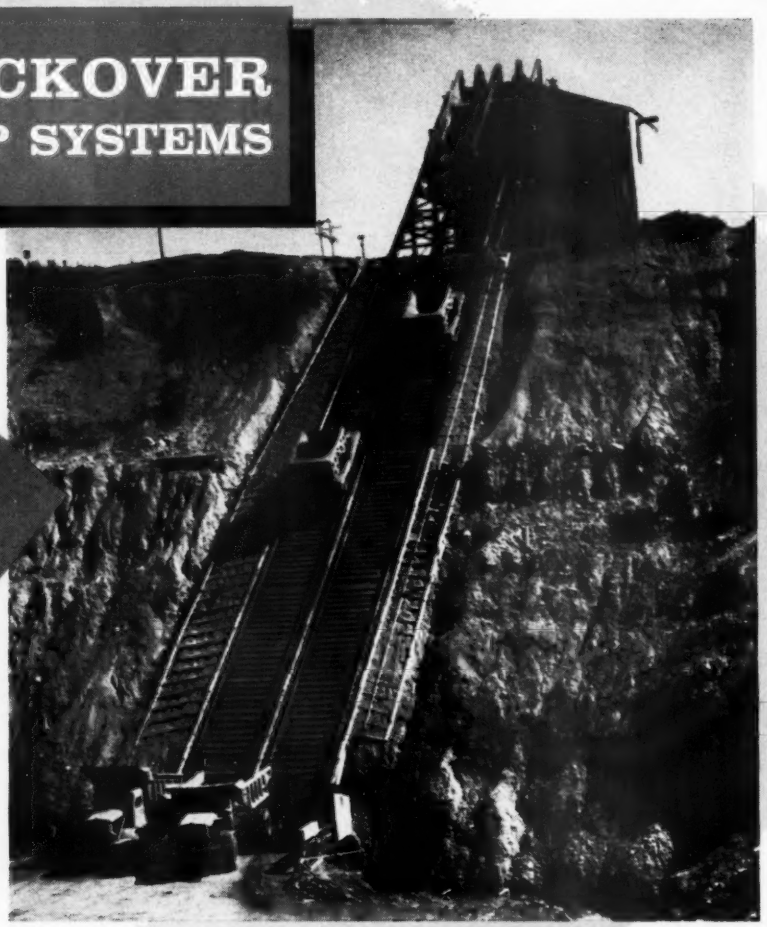
Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

Elevate materials at LOWEST COST PER TON

with **ROCKOVER SKIP SYSTEMS**

IN USE SINCE 1949



The ROCKOVER SKIP SYSTEM has proven to be the most economical method to elevate materials from open pits. It uses the shortest and fastest hauling route, has the lowest operating and maintenance costs and requires no large investment in parts and standby equipment.

Rockover Skip Systems require no expensive wide roads for pit access and require a minimum of personnel . . . are flexible to follow pit bottom as operations go deeper . . . haul either waste or ore at anytime . . . may be loaded at any desired bench and require no sizing equipment in the pit.

NICO SKIPS FROM 15 TO 50 TON CAPACITIES AVAILABLE

Write for illustrated brochure.

NATIONAL IRON COMPANY

50th Avenue West and Ramsey Street ● Duluth 7, Minnesota

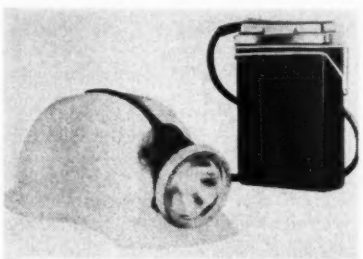
Subsidiary of Pettibone Mulliken Corp., Chicago 51, Illinois

manufacturers forum

Electric Cap Lamp

SAID TO PROVIDE 30 PERCENT MORE LIGHT than previous models with no increase in weight, the Wheat "National" Electric Cap Lamp is distributed and serviced exclusively by National Mine Service Co. The lamp is made by Koehler Mfg. Co.

Improved battery design and a new krypton gas-filled bulb with two equal-working filaments reportedly are together responsible for the increase in light output. A perfect spot reportedly can be made with either



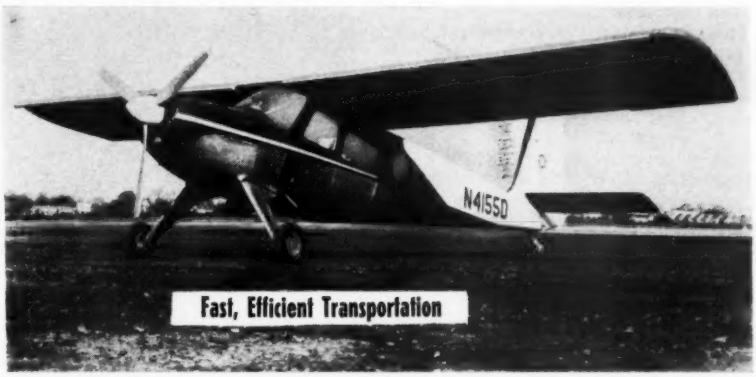
filament. By rotating the switch knob, the reflector moves to the best position for the desired focus of the light beam. The battery also includes improvements which contribute to increased resistance to vibration and hard use.

Additional details may be obtained from National Mine Service Co., 2530 Koppers Bldg., Pittsburgh 19, Pa.

100-KV X-Ray Spectograph

THE INSTRUMENT ANALYZES METALS, alloys, minerals, ores, chemical mixtures and compounds and covers a range of 87 elements in atomic scale extending from magnesium to californium. Available from the Instruments Division, Philips Electronics, Inc., 750 South Fulton Ave., Mt. Vernon, N. Y., the 100-kv Norelco X-ray spectrograph is said to operate at twice the potential formerly available and to incorporate many design improvements for the rapid qualitative and quantitative analysis for elements in liquids, powders and solids. Data obtained from the instrument can be quickly converted into percentages of the elements present.

The spectograph consists of two units. The main chassis assembly weighs 1600 lb, and the electronic circuit panel cabinet weighs 509 lb. Cooling water must be supplied at a rate of 3½ qt per minute at 30 psi (room temperature). Power requirements are 200 volts, 60 cycles, single phase, 25 amp.



THE FIVE-PLACE 295-hp Super Courier is said to have characteristics considered to be especially useful for mining, construction, oil and other companies with far-flung operations. According to the manufacturer, this model is the fastest, longest-range, most efficient load-carrying plane produced any place in the world that also is capable of attaining the helicopter-like STOL (Short Take-Off Landing) performance—namely, capable of taking off and landing over a 50-ft barrier in less than 500 ft with zero wind. The Super Courier has a 295-hp geared Lycoming engine with a 96-in. diameter, 3-blade Hartzel constant-speed propeller. It reportedly cruises at 170 mph, can fly as slowly as 30 mph, clear a 50-ft barrier in 475 ft with an approximate load of 1000 lb, and climb 1550 fpm. For more information write Helio Aircraft Corp., 230 Park Ave., New York 17, N. Y.

Lubricants

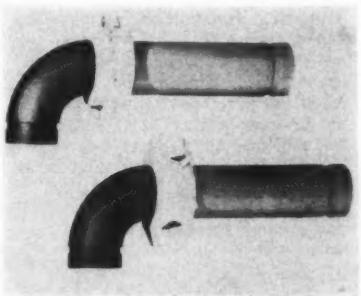
TWO ANTI-FRICTION lubricating compositions said to have no melting or dropping point have been announced by Whitmore Mfg. Co., Cleveland 4, Ohio. Of special use in the earth-moving, mining, quarrying, processing, and manufacturing industries, the Anti-Friction Compositions reportedly give constant protection to roller, ball, sleeve bearings, and sliding surfaces in "hot" bearing applications or in areas with high ambient heat. Whitmore's Anti-Friction Composition No. 1 has light density, and is recommended for high speed high temperature applications. Anti-Friction Composition No. 2, with its heavier density, is for low speed high temperature applications, or loosely-fitted bearings.

Truck Wheels

GREASING BY THE USER IS NO LONGER NECESSARY on Allis-Chalmers Positive Seal truck wheels, front idlers, and support rollers for the company's entire crawler tractor line. These wheels are lubricated at time of assembly and reportedly need no further greasing attention. Allis-Chalmers Mfg. Co., Milwaukee 1, Wis., states that this is an added operating advantage which now makes possible complete elimination of greasing the tractor undercarriage regardless of mud, water or other adverse operating conditions.

Plastic Fittings

A LINE OF FULL-FLOW MOLDED plastic pipe fittings with grooved ends, for quick-jointing plastic pipe with Victaulic mechanical couplings, has been announced by Victaulic Company of America, P. O. Box 509, Elizabeth, N. J. The fittings are molded in sizes from 1½-in. to 8-in. in three materials: regular polyethylene, special high temperature linear type polyethylene, and polypropylene. Elbows, tees, crosses, 45° laterals, reducers, caps and flanged adapter nipples for jointing to bolted flanged systems are available in all three materials.



Respirator Filter

THE VARIABLE DENSITY RESPIRATOR filter is said to have Bureau of Mines approval for respiratory protection against all dusts not significantly more toxic than lead, pneumoconiosis-producing and nuisance mists and chromic acid mist. The "Red Devil" filter is composed of two sections, a red prefilter and the filter body. The built-in prefilter is composed of interlocked viscose fibers and is thermally bonded to the filter body. This prefilter is constructed to trap larger sized airborne particles, agglomerates of smaller particles and a reasonable amount of microscopic particles.

The grey filter body is composed of a special combination of microfine viscose and vinyon fibers and ultrafine asbestos fibers. The viscose and vinyon fibers form a constant latticework throughout the filter body upon which the extremely fine asbestos fibers are deposited. These asbestos fibers vary in density from front to back, having the heaviest concentration at the innermost part of the filter. Because of this concentration gradient, the filtering efficiency increases from front to back and rapid plugging of the filter is prevented. This variable density feature also reportedly prevents a rapid increase in breathing resistance by the filtering action which traps larger particles at the front of the filter while allowing smaller particles to penetrate until they are finally trapped by the increasingly dense asbestos fibers.

The Red Devil is made to fit standard AO single and twin cartridge respirators. For more information write to American Optical Co., Southbridge, Mass. for Bulletin S-8093.

Wagon Crane

A 45-TON wagon crane has been added to Marion Power Shovel Co.'s line of excavating machinery. Designated the Type 362 Wagon Crane, the off-highway unit was designed primarily as a rehandling machine and for drop ball application in quarries. It can carry up to 120 ft of boom and 15 or 20 ft jibs for added versatility in crane work. Mounted on a 20 ft 1 in. Maxi carrier, the wagon crane has a working weight of 111,700 lb. Power is furnished by either a GM 6-71 diesel with electric starter and straight drive standard, or a Cat D326F with gasoline engine starter with speed reducer drive standard.

Device for Detection of Fire, Smoke and Vapors

AN ULTRAVIOLET-SENSITIVE TUBE developed at the Honeywell Research Center reportedly can simultaneously detect fire, smoke and combustible vapors, according to Minneapolis-Honeywell Regulator Co. Honeywell already is working with a major coal mining equipment manufacturer on application of the tube in the coal mining industry.

In a typical warning system, the tube would work with an amplifier circuit to add up the impulses of electrical energy generated by the tube as it counts ultraviolet rays. Whenever the rate of these impulses exceeded a specific rate, an alarm would be sounded, equipment turned off, sprinklers started, etc.

New control systems using the ultraviolet-sensitive tube already are on the Honeywell drawing boards. Pilot production currently is being carried on at the company's Research Center in the Minneapolis suburb of Hopkins, with full-scale production eventually to be transferred to Honeywell's Semiconductor Products Department in Minneapolis.

130-Ton Capacity Earthmovers

MORE THAN 100-FT LONG and as powerful as a railroad locomotive; this describes the 130-ton capacity earthmover which has been introduced by R. G. LeTourneau, Inc.

A single operator, with one hand on a panel of push-button controls, is in complete command of the machine as it goes through each stage of its work. One operator can dig a boxcar full of dirt, haul the load to any desired location, then spread the load with an even finish.

Two giant "buckets" are incorporated to hold the 130-ton load. Both buckets are integral parts of the machine—they can load themselves separately and discharge their loads either together or separately as the operation requires.

The most important factor making this large earthmover practicable is said to be LeTourneau's "electric wheel" system of propulsion. Two 600-hp diesel engines drive a-c and d-c dynamos under the hood. The dynamos furnish power to drive d-c electric motors which are geared directly to the "rims" of all eight wheels—and also to drive a-c motors spotted at other strategic locations on the machine.

Readers interested in more details concerning the company's new lines of earthmoving equipment may write to R. G. LeTourneau, Inc., 2399 South MacArthur, Longview, Texas.

Welder

A PORTABLE twin Arc-Welder has been announced by Engine Division, Caterpillar Tractor Co., Peoria, Ill. The welder, equipped with either skid base or running gear, uses the Cat D311 (Series H) diesel engine and two Lincoln electric welding generators.

The generators each have a rating (NEMA) of 300 amp at 40 volts for simultaneous operation of two arcs. For parallel operation the Twin-Arc Welder is rated at 600 amp, 40 volts. The current range of each generator is 60 to 375 amp. Two sets of generator controls allow welding at different voltages, amperages and polarity at the same time to permit precision adjustment for any type or size arc throughout the current range.

A three-kw capacity exciter provides a constant source of magnetic flux to the generators and 1.5 kw or more of power to two 115-volt d-c auxiliary equipment outlets.

Tire Valves

A LINE OF TUBE AND TUBELESS tire valves for off-the-road equipment includes rubber-base type valves, screw-on repair tube valves, spudes for tubes, air-water valves, tubeless valves, and a complete group of valve extensions for rubber base or screw-on repair valves. Additional information may be obtained from Dill Manufacturing Co., 700 East 82nd St., Cleveland 3, Ohio.

Decelerator for Tractor

A FOOT-OPERATED decelerator for the Caterpillar D8 Tractor has been made available by Caterpillar Tractor Co., Peoria, Ill. The new component, which permits an operator to slow the engine without using the hand throttle, is an optional attachment for both direct drive and torque converter drive tractors. When the decelerator is released, the engine returns automatically to the hand throttle setting. Linkage for the foot decelerator is connected to the diesel engine governor, and is entirely independent of the hand throttle setting. The prime advantage of the decelerator is to free the operator's hand for other control levers such as the flywheel clutch, cable control or hydraulic control.

Rotary Air Compressor

A LINE OF PORTABLE rotary air compressors, featuring "Perma-Vane" rotor blades, has been announced by Davey Compressor Co., Kent, Ohio. Of special solid, lightweight material, Perma-Vane blades are said to have greater wear resistance than those used in most rotary machines. The blades' lightweight and minimum friction are also reputed to reduce horsepower required by the compressor and to afford important operating economies. The new line, offered under the trade name of Davey Hydrovane Rotary, includes portable compressors of 125 to 600 cfm capacities.

Electric Mortar Grinder

THE MOTOR DRIVEN mortar and pestle grinds any material quickly and thoroughly to any graduation required, according to Torsion Balance Co., Clifton, N. J. Both pestle and mortar are made from a special grade of hard porcelain which can grind such materials as coal, coke, quartzite, clinker, glass and fireclay. For grinding harder materials, three sets of mortars and pestles are available. One is made from a specially selected tough steel of high abrasion resistance, one from agate, and another from sintered corundum.

— *Announcements* —

Dr. N. B. Sommer has been appointed manager of **American Cyanamid Company's** Explosives and Mining Chemicals Department, and **George C. Holton** has been named assistant to the general manager, Organic Chemicals Division.

Sommer, formerly assistant to the executive vice president, has been with Cyanamid since 1944.

Holton, who has been with Cyanamid since 1934, has served the company's Explosives Department as sales manager, assistant to the manager, assistant manager and department manager.

Ohio Brass Co. has announced the election of four vice presidents; **Joseph T. Lusignan, Louis J. Ott, Estes C. Thompson,** and **J. Howard Holan.**

L. J. Ott

Lusignan has been elected vice president — engineering and will continue to head all O-B engineering activities. Ott has been elected vice president and will continue as general sales manager. Thompson has been elected vice president—manufacturing and will continue as general factory manager. Holan has been elected vice president and will continue to serve as president and treasurer of **Holan Corp.,** an O-B subsidiary.

J. V. S. Norton has been named assistant sales manager, Eastern Region, by **Bucyrus-Erie Co.** He had been assistant export sales manager for the last 21 months, working out of the home office.

Floyd R. Anderson, administrative assistant of the Denver Division, **Gardner-Denver Co.,** has been named chief metallurgist for the company. He will supervise metallurgical operations of all divisions, domestic and foreign.

Joy Mfg. Co. has announced three recent personnel changes. **A. W. Calder** has been appointed director of engineering in the Coal Machinery Division, and **John Merck** was named manager of engineering, Franklin products, in the Coal Machinery Division.

At the same time **Howard E. Butters** was named sales manager, Mining and Construction Division.

Robert J. Russell is the newly appointed executive vice president of **Hardinge Co., Inc.** Russell joined Hardinge in 1929, was elected vice president in charge of sales in 1953, and subsequently assumed the additional duties of corporation treasurer, a position he still retains.

Several personnel appointments have been made by **Western Machinery Co.** and **Western-Knapp Engineering Co.**

Jack Keller has been appointed assistant to the general manager of the Industrial Sales Division of Western Machinery Co.

Edward J. O'Connell has been named executive assistant to the vice president and general manager of Western-Knapp, and **W. H. Brett** has been named Chicago District sales manager.

Gerould A. Sabin, advertising director of **Colorado Fuel and Iron Corp.,** was presented with the award, "Advertising Man of the Year" at a recent meeting of the Advertising Club of Denver.

Fay Munger has been named manager of the Mining Research and Development Division for **Jeffrey Mfg. Co.** He succeeds **Sterling C. Moon** who died in an automobile accident early in January.

Thomas O. Rees, Jr., has been appointed advertising manager of the Mining and International Group of **Mine Safety Appliances Co.**

Chester H. Sanderson continues as advertising manager of MSA's Industrial Group.

CATALOGS & BULLETINS

DIALYSIS SYSTEM. *Sales Promotion, Graver Water Conditioning Co., 216 West 14th St., New York 11, N. Y.* The Hi-Sep dialysis system is described in Bulletin WC-121. Covered in the bulletin are design, operation, applications and advantages of the Hi-Sep Dialyzer. Engineering drawings illustrate construction and operation. Any company that uses acid in processing and that now goes through great expense for neutralization or for recovery will find this bulletin interesting. It will also be of interest to those having problems with caustic and neutral salt recovery.

STATIONARY COMPRESSORS. *Atlas Capco Eastern, 610 Industrial Ave., Paramus, N. J., or Atlas Capco Pacific, 930 Brittan Ave., San Carlos, Calif.* Designated "Leaflet A889-1," the folder provides complete operating data on Atlas Capco's AR compressor series which deliver from 330 to 3220 cfm at 100 psi.

BELT CONVEYORS. *Western Machinery Co., 650 Fifth St., San Francisco 7, Calif.* In addition to a description of Western Machinery Company's conveyor, this bulletin contains engineering data on how to estimate conveyor requirements including capacity charts, recommended belt speeds, horsepower requirements, maximum angles of inclination and required conveyor lengths.

CRUSHERS. *Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.* Allis-Chalmers is making available to users of its crushers a manual completed on an IBM machine which expedites supplying of renewal parts and shows at a glance what parts are interchangeable on various Allis-Chalmers machines of the same type. The system is now complete for many recent models of Allis-Chalmers crusher family and is being developed for other of the company's processing machinery. The new manual lists a catalog number, quantity, description, and the Allis-Chalmers part number for every part of the customer's crusher.

(Continued on next page)

(Continued from previous page)

THICKENERS. *Process Engineers, Inc., Division of Eimco Corp., 420 Peninsular Ave., San Mateo, Calif.* Brochure covers various types of Eimco-Process Thickeners and related equipment for the chemical, metallurgical and industrial fields. Bulletin SM-1004 describes beam, truss and center-column supported thickener mechanisms; traction thickeners; balanced, washing and combination tray thickeners; reactor-thickeners; hydroseparators; air-lift agitators; and slurry mixers, as well as special thickeners for corrosive, elevated pressure and high-temperature service.

CONVEYOR. *Goodman Mfg. Co., Halsted St. & 48th Place, Chicago 9, Ill.* Catalog G-130 describes the Goodman Ropebelt Conveyor. Advantages, dimensions and specifications are covered.

POLYVINYL CHLORIDE PIPING. *Plastic Products Division, B. F. Goodrich Industrial Products Co., Marietta, Ohio.* Catalog No. 10050-A describes the company's line of rigid Koroseal polyvinyl chloride piping, fittings and valves —covering both normal and high impact material. Besides listing specifications and physical properties of Koroseal piping, the catalog includes data about common chemicals that can be safely handled by Koroseal.

LIQUIDS HANDLING EQUIPMENT. *George D. Ellis & Sons, Inc., American & Luzerne St., Philadelphia 40, Pa.* A line of liquids handling equipment—including delivery cans, measuring buckets, funnels, test measures and filling stems—that is said to make it more convenient and economical to carry, fill, measure, test and transfer liquids for the petroleum, chemical, mine, railroad and construction industries is illustrated and described in a four-page folder, Products Memo No. 114.

MINE AND INDUSTRIAL TRACKWORK. *Publications Department, Bethlehem Steel Co., Bethlehem, Pa.* Catalog 470 lists trackwork material such as rails, steel ties, turnouts, tie sets, crossings, switches and frogs, and contains many useful tables and instructions. In addition to trackwork, there are sections dealing with Bethlehem's yieldable mine arches, mine roof ties, bolts and accessories, and mine cars.

ELECTRIC VIBRATING FEEDERS AND CONVEYORS. *Jeffrey Mfg. Co., Advertising Department, Columbus 16, Ohio.* Catalog 930 covers Jeffrey line of electric vibrating feeders and conveyors. Controls, installation methods, principles of operation and individual unit specifications are included in the 96-page book. Other vibrating equipment such as barrel packers and coolers and dryers as well as magnetic separators and bin level indicators are covered. Photographs, line drawings and installation views support the detailed exposition.

RESCUE BREATHING. *American Film Producers, 1600 Broadway, New York 19, N. Y.* The safety film is designed to teach the techniques of rescue breathing (mouth-to-mouth or mouth-to-nose). Experiments conducted by Dr. James O. Elam, director of the Department of Anesthesiology, Roswell Park Memorial Institute, Buffalo, N. Y., form the basis of the film. The completed production has a running time of approximately 21½ minutes, and is being distributed by American Film Producers who edited, added animation and otherwise completed the training film. Write for price schedule and additional information.

CONTINUOUS MINING MACHINE. *Joy Manufacturing Co., Oliver Bldg., Pittsburgh 22, Pa.* Modifications of the Joy 5CM Continuous Miner, including integral roof bolting drills and gathering arm cleanup, are described and illustrated in a specification sheet, Bulletin J-409. Designated as the 5CM-2B Miner, the machine uses a ripper bar to mine coal 45 to 88-in. high while controlling roof. Complete specifications on the miner plus rigid and tilting roof drills are included. An eight-page bulletin, J-406, describing the basic 5CM Continuous Miner is also available.

SPECTROPHOTOMETERS. *Beckman Scientific & Process Instruments Division, 2500 Fullerton Road, Fullerton, Calif.* Performance and versatility features of the Beckman DK Double-Beam Ratio Recording Spectrophotometers are illustrated in Bulletin 735. The brochure also lists specifications, operating convenience features, applications data, and accessories for the Beckman DK-1 and DK-2 Spectrophotometers.

MONTHLY TIME AND COST RECORD BOOK. *Advertising Division, Caterpillar Tractor Co., Peoria, Ill.* To assist owners in determining the cost of owning and operating equipment, Caterpillar Tractor Co. has prepared a special 24-page Monthly Time and Cost Record Book, Form 33215. Twelve sets of pages are included on which to record, day by day, each month's individual machine expenses for an entire year. At the end of the record section is an annual summary sheet where the totals for each month can be entered to obtain annual cost figures. To help compute owning and operating costs, a section at the back of the book explains simple methods of calculation. In order to record expenses as they occur in the field, a pocket size Daily Time and Cost Record booklet, Form 32818-G, is also available.

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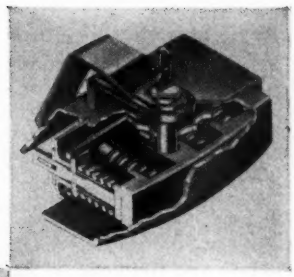

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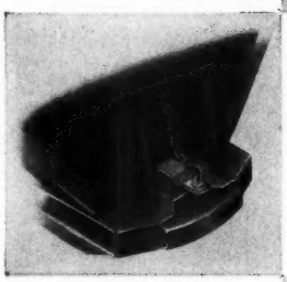

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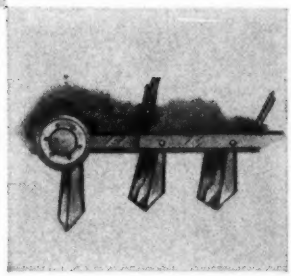

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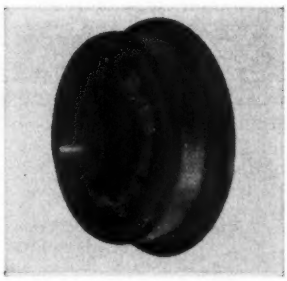

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